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FLOOD INSURANCE STUDY

ORIGINAL

TOWNSHIP OF PARSIPPANY-TROY HILLS, NEW JERSEY
MORRIS COUNTY

FEBRUARY 19, 1986

Federal Emergency Management Agency

COMMUNITY NUMBER - 340355

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PUBLISHED SEPARATELY:

Flood Insurance Rate Map Index
Flood Insurance Rate Map

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FLOOD INSURANCE STUDY
TOWNSHIP OF PARSIPPANY-TROY HILLS, NEW JERSEY

I. INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the Township of Parsippany-Troy Hills, Morris County, New Jersey, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for various areas of the community that will be used to establish actuarial flood insurance rates and assist the community in their efforts to promote sound flood plain management. Minimum flood plain management requirements for participation in the National Flood Insurance Program are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

In some states or communities, flood plain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the state (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for the detailed studied streams in this study, except the Rockaway River and Whippany River, were prepared by the New Jersey Department of Environmental Protection for the Federal Emergency Management Agency (FEMA), under Contract No. 24, Project R. This work was completed in December 1980. The hydrologic and hydraulic analyses for this study were conducted by the URS Company, Inc., under subcontract to the New Jersey Department of Environmental Protection. The study of the Rockaway River was prepared by Dewberry & Davis under agreement with FEMA. The study of the Whippany River was prepared by the RBA Group under agreement with FEMA. The work for the Rockaway and Whippany Rivers was completed in January 1984.

1.3 Coordination

An initial Consultation and Coordination Officer's (CCO) meeting was held by representatives of FEMA and the State Coordinating Agency to determine the streams to be studied by detailed and approximate methods. A search for data was made at all levels of government, including local officials.

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In November 1978, a request was made to the mayor and township engineer for available stream cross section data, profiles, topographic maps, drainage maps, recorded flood marks from past storms, local flood protection improvements, history of the township, and available bench mark data. To develop the Rockaway River study, coordination was required between Dewberry & Davis; the New Jersey Department of Environmental Protection (NJDEP); the U. S. Army Corps of Engineers (COE); the RBA Group; Elson T. Killam and Associates; and Camp, Dresser, and McKee, Inc.

On July 18, 1984, a final CCO meeting was held, attended by representatives of FEMA, the State of New Jersey, the URS Company, Inc., and local officials.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the Township of Parsippany-Troy Hills, Morris County, New Jersey. The area of study is shown on the Vicinity Map (Figure 1).

Six streams were studied by detailed methods in the township. These include the Rockaway River, which was studied for its entire stream length affecting the community; the Whippany River, studied for its entire stream length affecting the community; Troy Brook, studied from its confluence with the Whippany River to the downstream side of Cherry Hill Road; West Brook, studied from its confluence with Troy Brook to just upstream of West Brook Pond Dam; Eastmans Brook, studied from its confluence with Troy Brook through Lake Parsippany; and Watnong Brook, studied from the downstream corporate limits through Powder Mill Pond. Flooding from the Passaic River affects the lower portions of the Rockaway River, the Whippany River, Troy Brook, and West Brook. In addition to the above mentioned streams, the Boonton Reservoir was studied as part of the Rockaway River; Forge Pond was studied as part of Troy Brook; Lake Parsippany was studied as part of Eastmans Brook; and Powder Mill Pond was studied as part of Watnong Brook. The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development and proposed construction through January 1989.

2.2 Community Description

The Township of Parsippany-Troy Hills is located in eastern Morris County. The township is 12 miles northeast of Morristown and approximately 25 miles west of New York City. Parsippany-Troy Hills is bordered by the Town of Boonton and Borough of Mountain Lakes to the north; the Borough of Morris Plains, and the Townships of Morris, East

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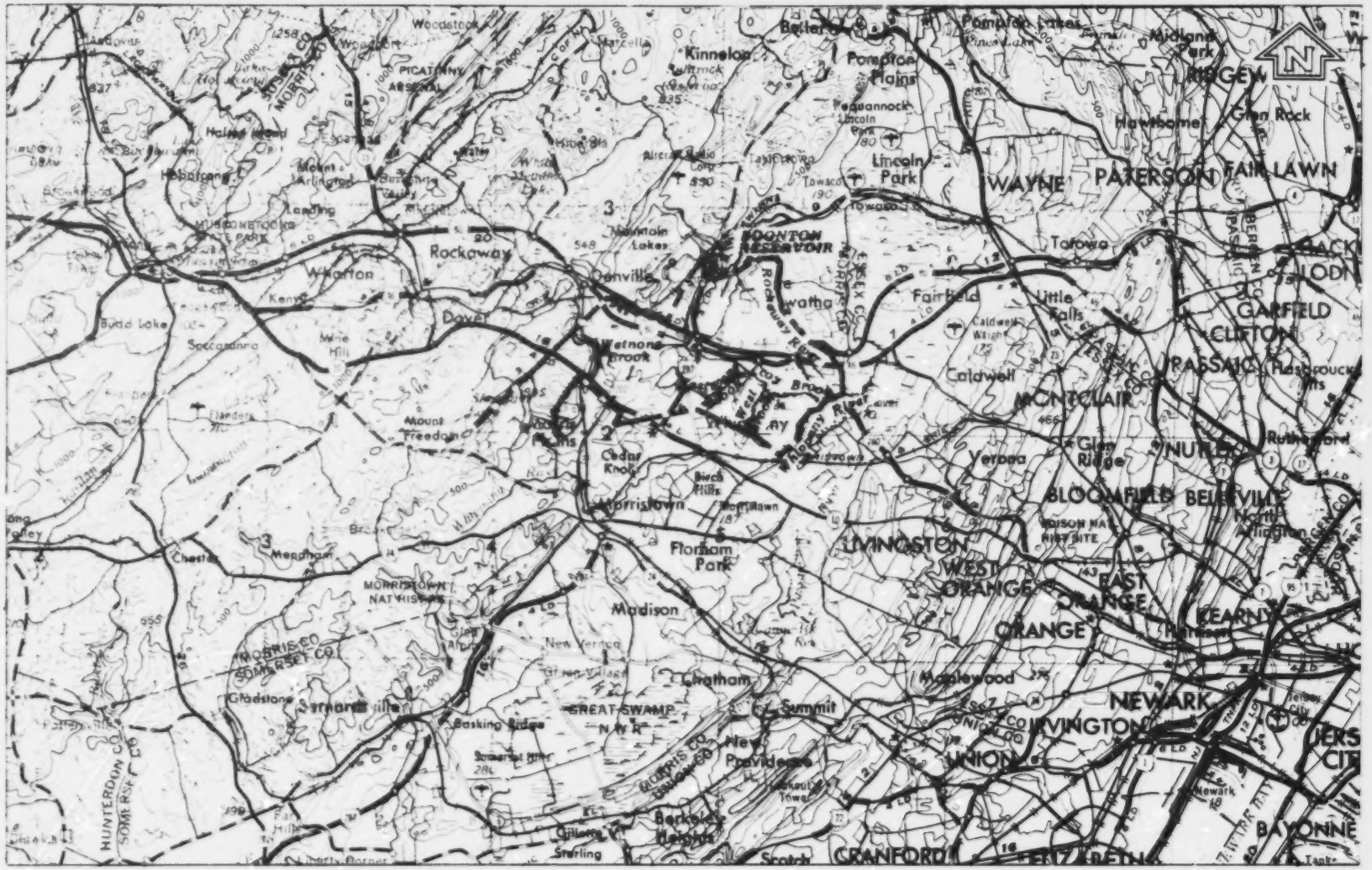

FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF PARSIPPANY-TROY HILLS, NJ
(MORRIS CO.)

APPROXIMATE SCALE

4 0 4 8 12 MILES

VICINITY MAP

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Hanover, and Hanover to the south; the Township of Denville to the west; and the Township of Montville to the east.

The Township of Parsippany-Troy Hills traces its origin back to the iron ore industry (Reference 1). The first iron ore forge opened in 1713 and enabled the community to flourish. After the Civil War, the township was used mainly as a summer retreat. During World War II, the housing shortage forced the summer cottages to become year-round residences. The post-war period has been one of continued growth. This is due partially to the easy access provided by U. S. Route 46 and Interstate Route 80 into the township (Reference 2).

Access by several major roads into Parsippany-Troy Hills has increased the growth of the community. U. S. Route 46, Interstate Routes 80 and 280, and State Route 10 provide east-west transportation; while, Interstate Route 287, State Route 53, and U. S. Route 202 provide north-south transportation. In addition, there are numerous county roads, and the township is also serviced by Conrail.

The total land area of Parsippany-Troy Hills is 16,192 acres (25.3 square miles). A 1974 survey indicated that one-half of the 4,000 acres still vacant was zoned residential. If this land were developed, there could be an increase in population of approximately 16,000 persons. There has already been tremendous growth in the township as seen in the population growth of 15,300 in 1950 to 50,101 in 1977. The 1980 population of the township was 49,868 (Reference 3).

In addition to rapid residential development, the community has experienced a substantial amount of commercial development. Major shopping centers have been built along U. S. Route 46, and industrial plants have been located along Interstate Route 287 and in the Fox Hill area.

In Parsippany-Troy Hills, a large portion of the developed land is paved and has inadequate storm water drainage. The typical vegetative cover in the residential areas is that of lawns with patches of natural woods. The State and Wildlife Preserves, Inc., owns over 1,800 acres of Troy Meadows land. This entire area is classified as a flood hazard location and is a planned wildlife refuge and conservation center.

There are several streams which cross the Township of Parsippany-Troy Hills. The Rockaway River provides a natural border with the Township of Montville, and it has a drainage area of 203.9 square miles at its confluence with the Passaic River. The Whippany River has a drainage area of 69.04 square miles at its confluence with the Passaic River. Troy Brook, which drains a large portion of the township, has a drainage area of 15.03 square miles at its confluence with the Whippany River. West Brook is located at the western edge of Troy Meadows and has a drainage area of 1.53 square miles at its confluence with Troy Brook.

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Eastmans Brook, located in the south-central portion of the township, has a drainage area of 2.87 miles at its confluence with Troy Brook. Watnong Brook, located in the southwest portion of the township, flows south and has a drainage area of 2.93 square miles at the corporate limits with the Borough of Morris Plains.

The Township of Parsippany-Troy Hills is characterized by a temperate climate with warm summers and cold winters. Average daily temperatures vary from 25 degrees Fahrenheit (°F) in January to 70°F in July. Extremes of temperature have ranged between approximately 10°F and 100°F. Average annual precipitation in the region is approximately 48 inches. Rainfall distribution is generally even, with August the wettest month and January the driest month. Record daily rainfalls in Morris County have been over 7 inches.

Parsippany-Troy Hills is located near the western edge of one of the four physiographic provinces which divide New Jersey. Each province has its own distinct geologic history and characteristics. Most of the township lies within the Piedmont Province. This area in New Jersey is underlain by rock formations deposited during the Triassic era; therefore, the region is known as the Triassic Lowlands (Reference 4). The characteristic rock formations of this region are sandstone and red shale.

A small section of the township lies in the adjacent New Jersey Highlands of the New England Physiographic Province. This region is characterized by northeast trending ridges which are separated by long, broad valleys. These ridges are composed of hard, crystalline Precambrian igneous and metamorphic rocks. The valleys are underlain by easily eroded shale and limestone (Reference 5).

Three soil associations cover the Township of Parsippany-Troy Hills. The soils from west to east are the Parker-Edneyville association, the Netcong-Rockaway association, and the Riverhead-urban land-Pompton association (Reference 4). The first two associations contain stony, sandy loams which overlie granitic gneiss on the upland. The Riverhead association contains poorly drained, gravelly sandy loams which overlie outwash sand and gravel.

2.3 Principal Flood Problems

The Township of Parsippany-Troy Hills has had a history of severe flooding. In May 1968, over 200 homes and businesses were damaged by flooding along the Rockaway River. Damages were estimated at one and one-quarter million dollars. In September 1971 and January 1979, severe flooding was also experienced within the township. Damages from these floods were estimated at more than one million dollars.

The most severe damages were sustained by the residential community of Lake Hiawatha. In May 1968, 30 homes along River Drive, Rockaway Avenue,

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and Lakeshore Drive were evacuated. Again in March 1970, 30 people had to be evacuated. During a flood in September 1971, a ten-block area was flooded and evacuations had to be made by boat. U. S. Route 202, from U. S. Route 46 to Littleton Road, was completely inundated; further, Jersey City's Boonton Reservoir was reported to have overflowed as a result of approximately 11 inches of rainfall. Water levels rose to 10 feet in some areas. In June 1972, February 1973, and twice in 1977, floods on the Rockaway River caused local residents to experience significant losses (Reference 6).

The USGS gage (No. 01380500) on the Rockaway River in the Town of Boonton shows the largest flood in the area occurring on January 25, 1979, with a peak discharge of 5,430 cfs. This flood has a recurrence interval of approximately 40 years (Reference 7). Over 200 people were forced to leave their homes during this flood. The U. S. Geological Survey (USGS) reported that this flood was the highest since their gage began operating in 1903 (Reference 7). The most recent recorded flood occurred on May 12, 1981, with a peak discharge of 2,040 cfs (Reference 7).

In addition to the flooding in Lake Hiawatha, sections of the township south of U. S. Route 46 have been subject to flooding from the numerous streams (Whippany River, Troy Brook, and Eastmans Brook) which flow east into Troy Meadows and eventually into the Rockaway River. Also, Watnong Brook has caused minor flooding in the Mount Tabor area of Parsippany-Troy Hills.

Figure 2 shows estimated flood heights on the Rockaway River.

2.4 Flood Protection Measures

The Township of Parsippany-Troy Hills has no major flood control works within the Rockaway Basin which affect flooding. Boonton Reservoir is designed and operated as a water supply reservoir and has no noticeable effects on the Rockaway River flood flows.

Due to numerous floods causing damage in the community, many plans have been made for flood protection measures. The Passaic River Study group of the COE, New York District, has made a major effort to provide flood protection (References 8 and 9). Their study, however, is still at the feasibility level and no action is anticipated within the next five years.

In 1972, the firm of Bowe-Walsh and Associates, Inc., prepared a document, Comprehensive Report, Proposed Storm Sewer System, Township of Parsippany-Troy Hills (Reference 10). The improvements outlined in this plan are not expected to have an appreciable effect on riverine flooding within the community.

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Figure 2. Estimated flood heights on the Rockaway River at Knoll Road looking downstream.

The publication Drainage Study, Morris County, New Jersey, includes recommendations for cleaning and improving and/or replacing structures in the township to increase their capacity during flooding (Reference 12). These measures, however, will have no discernable effect on the 100-year recurrence interval which is the basis of this study.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for flood plain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1 percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect

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flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for each flooding source studied in detail affecting the community.

Discharge-frequency relationships for the Rockaway River and the Whippany River were defined using procedures outlined by the Interagency Advisory Committee on Water Data in Bulletin 17B (Reference 12). A log-Pearson Type III distribution of annual peak discharges from the U. S. Geological Survey (USGS) stream gage (No. 01380500), upstream of Boonton Reservoir, was used to determine values of the 10-, 50-, 100-, and 500-year peak discharges at the gage (Reference 7). These discharges and other hydrological information were used to calibrate the COE HEC-1 model of the Passaic River Basin in which the Rockaway River Basin is included (Reference 13). Parsippany-Troy Hills is located along the Rockaway River approximately 1.5 miles upstream of the confluence of the Rockaway River with the Passaic River; however, Parsippany-Troy Hills is directly affected by the Passaic River.

The hydrologic analysis for the portion of the Passaic River Basin, in which Parsippany-Troy Hills is located, is complex because three rivers, the Passaic River, the Rockaway River, and the Whippany River, come together in a flat, swampy area. This produces conditions in which the flood elevations from the Passaic River control over the lower reaches of the Rockaway and Whippany Rivers for the 50-, 100-, and 500-year floods; however, the flood elevations from the Rockaway and Whippany Rivers control the 10-year flood.

For the Rockaway River, a combination of two runs, HEC-2-Run A and HEC-2-Run B, of the COE HEC-2 model with different discharges, were used to obtain the final water-surface profiles (Reference 14). The first run, HEC-2-Run A, used the 10-year discharges on the Rockaway River which occurs when the Rockaway River peaks at its confluence with the Passaic River. This point was identified on the COE HEC-1 model as Node 20. These discharges were used because the 10-year water-surface elevations generated from the HEC-2-Run A analysis are higher and, thus, have a controlling effect. Also, the 50-, 100-, and 500-year discharges from the HEC-2-Run A model were used upstream of a point approximately 26,850 feet above the confluence of the Rockaway River with the Passaic River for the above mentioned reason.

Between the confluence of the Rockaway River with the Passaic River and a point 26,850 feet above the confluence with the Passaic River, the 50-,

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100-, and 500-year discharges from the second run, HEC-2-Run B, were used. HEC-2-Run B used coincident discharges on the Rockaway River. These discharges occur when the Passaic River is peaking just downstream of the Pomptom River in the Borough of Lincoln Park. This point was identified on the COE HEC-1 model as Node 35. These discharges were used because the 50-, 100-, and 500-year water-surface elevations generated from the HEC-2-Run B analysis control between the confluence and a point approximately 26,850 feet above the confluence with the Passaic River.

For the Whippany River, the same type of analysis was utilized. Two runs, HEC-2-Run C and HEC-2-Run D, of the COE HEC-2 model with different discharges, were used to obtain the final water-surface profiles (Reference 14). The 50- and 100-year discharges from HEC-2-Run D, which occurred when the Passaic River peaks just downstream of the Pomptom River, were used between the confluence with the Rockaway River and a point approximately 15,180 feet above the confluence. Upstream of that point, the 50- and 100-year discharges from the HEC-2-Run C analysis were used, which occurred when the Rockaway River peaks. This point was identified on the COE HEC-1 model at Node 20. The HEC-2-Run C model also gives peak Whippany River discharges, because the Rockaway and Whippany Rivers have coincident peaks. The 10-year discharges for the Whippany River were also obtained from HEC-2-Run C. The 500-year discharges from HEC-2-Run D were used between the confluence with the Rockaway River and a point approximately 19,860 feet above the confluence. Upstream of this point the 500-year discharges from HEC-2-Run C were used. This model, developed by the COE for the Hydrologic Study, Passaic River Report, which is a preliminary, ongoing study, subject to revision, provided the discharge breakdown along the Rockaway River and the Whippany River (Reference 15).

Peak discharges for the 10-, 50-, 100-, and 500-year recurrence intervals for Troy Brook, West Brook, Eastmans Brook, and Watnong Brook were developed using Special Report 38, Magnitude and Frequency of Floods in New Jersey with Effects of Urbanization (Reference 16).

A summary of the drainage area-peak discharge relationships for the streams studied by detailed methods is shown in Table 1, "Summary of Discharges."

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
ROCKAWAY RIVER					
Upstream of confluence with Whippany River	134	2,774	5,302	6,479	10,361
At Knoll Road	129	2,680	5,378	7,230	12,530

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TABLE 1 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
ROCKAWAY RIVER - continued					
Downstream of Boonton Reservoir	119	2,409	4,951	6,873	11,888
Upstream of Boonton Reservoir (USGS gage No. 01380500)	116	3,601	6,224	7,509	11,623
WHIPPANY RIVER					
At the confluence with Rockaway River	69.04	2,985	4,114	4,673	5,571
At Conrail	50.20	2,446	3,479	4,073	5,390
TROY BROOK					
Upstream of confluence with Whippany River	15.03	710	1,140	1,317	1,985
Upstream of confluence of West Brook	10.95	790	1,260	1,520	2,205
Upstream of confluence of Eastmans Brook	6.77	625	1,010	1,220	1,790
WEST BROOK					
At confluence with Troy Brook	1.53	95	165	205	240
EASTMANS BROOK					
At the confluence with Troy Brook	2.87	180	305	370	560
Upstream of confluence of Tributary No. 1	1.53	85	150	185	285
At Lake Parsippany Dam	1.07	60	105	130	205
WATNONG BROOK					
At downstream corporate limits	2.93	625	1,005	1,225	1,860
Upstream of confluence of Tributary No. 1	2.33	495	800	980	1,500

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals.

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Cross sections for the backwater analysis of the Rockaway River and Whippany River provided by the COE were determined by combining field surveyed channel and bridge data with overbank topographic data taken from aerial mapping (Reference 17). Channel cross sections and partial overbank cross sections for Troy Brook, West Brook, Eastmans Brook, and Watnong Brook were obtained through field surveys and topographic data (Reference 18). All bridges and culverts were field surveyed to obtain elevation data and structural geometry.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross section locations are also shown on the Flood Boundary and Floodway Map (Exhibit 2).

Channel roughness factors (Manning's "n") used in the hydraulic computations were chosen by engineering judgment and based on field observations of the stream and flood plain areas (Reference 19). The following tabulation shows the channel and overbank "n" values for the streams studied by detailed methods.

Stream	Channel "n"	Overbank "n"
Rockaway River	0.012-0.045	0.035-0.100
Whippany River	0.025-0.030	0.070-0.100
Troy Brook	0.022-0.035	0.080-0.120
West Brook	0.033-0.035	0.090-0.125
Eastmans Brook	0.017-0.035	0.040-0.125
Watnong Brook	0.015-0.040	0.060-0.125

Water-surface elevations of floods of the selected recurrence intervals were computed using the COE HEC-2 step-backwater computer program (Reference 14). Flood profiles were drawn showing computed water-surface elevations for floods of the selected recurrence intervals. Along certain protions of Troy Brook and Eastmans Brook, a profile base line is shown on the maps to represent channel distances as indicated on the flood profiles and floodway data tables. Along certain portions of the Rockaway River through Boonton Reservoir, a profile base line is shown coincident with the corporate limits to represent channel distances as indicated on the flood profiles and floodway data tables.

Portions of the data for the hydraulic analyses on the Rockaway River were taken from the Hydrologic Study, Passaic River Study, which is a preliminary, unpublished, ongoing study, subject to revision (Reference 15). Starting water-surface elevations for the 10-year flood and floodway analysis for the Rockaway River downstream of Boonton Reservoir were developed from the peak flood of the Rockaway River at the confluence with the Passaic River by normal depth calculations (Reference 20). The starting water-surface elevations for the 50-, 100-, and 500-year floods of the Rockaway River were taken from the Passaic River

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profiles at the confluence with the Rockaway River (Reference 20). This was done since the Rockaway River is controlled by the Passaic River when it is peaking just downstream of the Pomptom River (Reference 15). Water-surface elevations upstream of the Boonton Reservoir Dam were computed by the use of outlet rating curves assuming that the bascule gates are in the down position (Reference 15). Starting water-surface elevations for the Rockaway River above Boonton Reservoir were taken from the water-surface elevations developed upstream of the Boonton Reservoir Dam (Reference 15). The starting water-surface elevations on the Whippany River were taken from the flood profiles for the Rockaway River, since the two streams are affected by similar hydrologic conditions. The starting water-surface elevations for Watnong Brook were taken from the Flood Insurance Study for Morris Plains (Reference 21). The starting elevations for all the other detailed streams in the township were determined using the slope/area method.

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in this study are shown on the maps.

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program encourages State and local governments to adopt sound flood plain management programs. Therefore, each Flood Insurance Study produces maps designed to assist communities in developing flood plain management measures.

4.1 Flood Boundaries

To provide a national standard without regional discrimination, the 1 percent annual chance (100-year) flood has been adopted by FEMA as the base flood for flood plain management purposes. The 0.2 percent annual chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the 100- and 500-year flood plain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps (References 17 and 18).

The 100- and 500-year flood plain boundaries are shown on the Flood Boundary and Floodway Map (Exhibit 2). In cases where the 100- and 500-year flood plain boundaries are close together, only the 100-year

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flood plain boundary has been shown. Small areas within the flood plain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

4.2 Floodways

Encroachment on flood plains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the area of the 100-year flood plain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent flood plain areas, that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. Minimum federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. However, the State of New Jersey has established criteria limiting the increase in flood heights to 0.2 foot. Thus, floodways having no more than a 0.2-foot surcharge have been delineated for this study. The floodways in this study are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodways presented in this study were computed on the basis of equal conveyance reduction from each side of the flood plain. The results of these computations are tabulated at selected cross sections for each stream segment for which a floodway is computed (Table 2).

As shown on the Flood Boundary and Floodway Map (Exhibit 2), the floodway boundaries were computed at cross sections. Between cross sections, the boundaries were interpolated. In cases where the floodway and 100-year flood plain boundaries are either close together or collinear, only the floodway boundary has been shown. No floodway was computed for the Rockaway River through Boonton Reservoir, since the HEC-2 analysis was not done for that section. The floodway on Watnong Brook was terminated at the beginning of Powder Mill Pond. The floodway on Troy Brook through Lake Parsippany and Eastmans Brook through Forge Pond were set adjacent to the stream banks. Floodway widths for the Rockaway and Whippany Rivers extend beyond the corporate limits.

The area between the floodway and 100-year flood plain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood by more than 0.2 foot

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FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH[2] (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Rockaway River								
A	7,700	1,390	6,015	1.1	174.4	173.5[3]	173.7	0.2
B	9,470	318	2,111	3.1	174.5	173.8[3]	174.0	0.2
C	10,890	752	4,820	1.3	174.8	174.2[3]	174.4	0.2
D	12,420	360	2,056	3.2	175.5	175.0[3]	175.2	0.2
E	13,165	806	6,052	1.1	176.4	175.9[3]	176.1	0.2
F	14,300	498	3,666	1.8	176.5	176.1[3]	176.3	0.2
G	18,100	1,420	7,972	0.8	176.9	176.5[3]	176.7	0.2
H	19,930	858	5,304	1.2	177.0	176.7[3]	176.9	0.2
I	21,630	1,051	7,235	0.9	177.3	177.1[3]	177.3	0.2
J	24,070	1,406	6,456	1.0	177.5	177.3[3]	177.5	0.2
K	26,140	844	2,975	2.2	177.8	177.7[3]	177.9	0.2
L	28,647	185	1,038	6.3	178.7	178.7	178.8	0.1
M	30,869	91	875	8.3	184.4	184.4	184.6	0.2
N	32,829	613	2,091	3.5	187.6	187.6	187.7	0.1
O	33,534	245	1,400	5.2	188.3	188.3	188.4	0.1
P	34,516	299	1,594	4.5	189.9	189.9	190.0	0.1
Q	36,878	363	1,469	4.9	194.3	194.3	194.4	0.1
R	37,848	173	946	7.6	196.4	196.4	196.5	0.1
S	38,223	197	1,166	6.2	198.2	198.2	198.4	0.2
T	38,440	135	1,073	6.7	199.0	199.0	199.2	0.2
U	39,890	556	2,318	3.1	201.7	201.7	201.8	0.1
V	40,917	75	644	11.2	204.5	204.5	204.5	0.0

[1]Feet above confluence with Passaic River
[2]This width extends beyond corporate limits
[3]Elevation computed without consideration of backwater from Passaic River

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF PARSIPPANY - TROY HILLS, NJ

(MORRIS CO.)

FLOODWAY DATA

ROCKAWAY RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE	WIDTH[3] (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Rockaway River (continued)								
W	41,820[1]	337	2,846	2.5	211.4	211.4	211.6	0.2
X	47,075[1]	681	25,504	0.3	309.1	309.1	309.3	0.2
Y	49,245[1]	154	766	9.7	309.1	309.1	309.3	0.2
Whippany River								
A	985[2]	729	5,449	0.9	174.4	173.6[4]	173.8	0.2
B	1,750[2]	314	1,377	3.4	174.6	173.6[4]	173.8	0.2
C	2,385[2]	190	1,334	3.5	174.8	174.2[4]	174.4	0.2
D	2,765[2]	305	2,519	1.9	175.0	174.5[4]	174.6	0.1
E	3,810[2]	1,369	9,544	0.5	175.1	174.6[4]	174.8	0.2
F	5,215[2]	2,490	15,702	0.3	175.1	174.6[4]	174.8	0.2
G	7,005[2]	2,305	11,538	0.4	175.2	174.7[4]	174.9	0.2
H	9,615[2]	2,105	10,813	0.4	175.2	174.7[4]	174.9	0.2

[1]Feet above confluence with Passaic River

[2]Feet above confluence with Rockaway River

[3]This width extends beyond corporate limits

[4]Elevation computed without consideration of backwater from Passaic River

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF PARSIPPANY - TROY HILLS, NJ

(MORRIS CO.)

FLOODWAY DATA

ROCKAWAY RIVER - WHIPPANY RIVER

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FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Troy Brook								
A	2,580	357	1,224	1.1	175.1	170.0[2]	170.2	0.2
B	6,445	348	1,298	1.1	175.1	173.0[2]	173.2	0.2
C	8,765	263	871	1.6	175.1	174.2[2]	174.4	0.2
D	10,015	251	892	1.7	175.1	174.9[2]	175.1	0.2
E	10,705	152	432	3.5	175.5	175.5	175.7	0.2
F	13,100	100	247	6.1	179.7	179.7	179.7	0.0
G	14,650	61	163	9.3	196.9	196.9	196.9	0.0
H	17,810	259	913	1.3	227.9	227.9	228.1	0.2
I	20,190	60	139	8.8	251.1	251.1	251.1	0.0
J	21,110	130	409	3.0	262.9	262.9	263.0	0.1
K	21,930	279	804	1.5	264.5	264.5	264.7	0.2
L	25,230	116	238	5.1	279.4	279.4	279.5	0.1
M	27,920	91	437	2.8	289.1	289.1	289.1	0.0
N	28,700	150	318	3.8	291.8	291.8	291.9	0.1
O	29,220	100	340	3.6	294.1	294.1	294.2	0.1
P	30,100	165	469	2.6	301.9	301.9	302.0	0.1
Q	31,620	33	207	5.9	304.3	304.3	304.4	0.1
R	32,150	273	885	1.4	305.2	305.2	305.3	0.1
S	32,460	158	579	2.1	305.3	305.3	305.4	0.1
T	34,980	32	146	8.4	311.7	311.7	311.9	0.2

[1]Feet above confluence with Whippany River

[2]Elevation computed without consideration of backwater from Passaic River

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF PARSIPPANY - TROY HILLS, NJ

(MORRIS CO.)

FLOODWAY DATA

TROY BROOK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
						(FEET NGVD)		
West Brook								
A	700[1]	176	438	0.5	175.1	171.8[3]	171.9	0.1
B	2,680[1]	297	354	0.6	175.1	172.8[3]	173.0	0.2
C	5,110[1]	19	50	4.1	182.8	182.8	183.0	0.2
D	5,840[1]	17	28	7.4	186.9	186.9	186.9	0.0
E	7,330[1]	30	46	4.5	202.6	202.6	202.8	0.2
Eastmans Brook								
A	710[1]	27	48	7.7	218.3	218.3	218.3	0.0
B	2,565[1]	60	64	5.7	229.4	229.4	229.4	0.0
C	3,900[1]	26	48	7.7	236.9	236.9	236.9	0.0
D	5,930[1]	27	94	3.9	242.7	242.7	242.7	0.0
E	7,380[1]	22	99	3.7	244.4	244.4	244.5	0.1
F	10,020[1]	22	30	6.2	252.3	252.3	252.3	0.0
G	12,275[1]	30	58	3.2	271.3	271.3	271.3	0.0
Watnong Brook								
A	370[2]	193	1,534	0.8	448.5	448.5	448.7	0.2
B	782[2]	152	748	1.6	448.5	448.5	448.7	0.2
C	1,115[2]	250	1,140	0.9	448.7	448.7	448.9	0.2
D	1,575[2]	255	1,069	0.9	448.8	448.8	449.0	0.2
E	2,560[2]	100	202	4.8	451.5	451.5	451.5	0.0
F	3,600[2]	192	293	3.3	457.7	457.7	457.7	0.0
G	3,990[2]	185	663	1.5	458.4	458.4	458.5	0.1

[1]Feet above confluence with Troy Brook

[2]Feet above corporate limits

[3]Elevation computed without consideration of backwater from Passaic River

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF PARSIPPANY - TROY HILLS, NJ

(MORRIS CO.)

FLOODWAY DATA

WEST BROOK - EASTMANS BROOK - WATNONG BROOK

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FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Watnong Brook (continued)								
H	4,640	147	479	2.0	460.0	460.0	460.1	0.1
I	6,095	160	459	2.1	466.1	466.1	466.2	0.1
J	6,560	31	126	7.8	467.2	467.2	467.3	0.1

[1]Feet above corporate limits

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

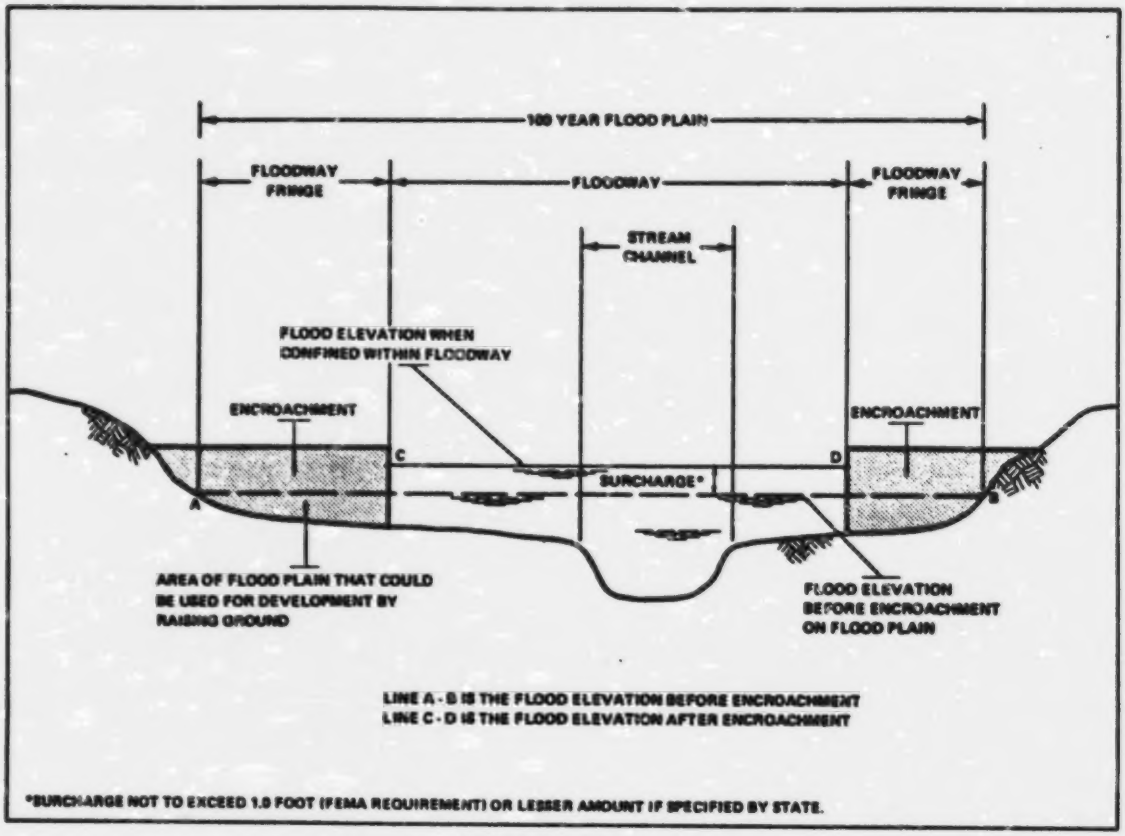
TOWNSHIP OF PARSIPPANY - TROY HILLS, NJ

(MORRIS CO.)

FLOODWAY DATA

WATNONG BROOK

at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain developments are shown in Figure 3.


100 YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE*
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE A - B IS THE FLOOD ELEVATION BEFORE ENCROACHMENT
LINE C - D IS THE FLOOD ELEVATION AFTER ENCROACHMENT
*SURCHARGE NOT TO EXCEED 1.0 FOOT (FEMA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE.

FLOODWAY SCHEMATIC Figure 3

Near the mouths of streams studied in detail, floodway computations are made without regard to flood elevations on the receiving water body. Therefore, "Without Floodway" elevations presented in Table 2 for certain downstream cross sections of the Rockaway River, the Whipppany River, Troy Brook, and West Brook are lower than the regulatory flood elevations in that area, which must take into account the 100-year flooding due to backwater from other sources.

5.0 INSURANCE APPLICATION

To establish actuarial insurance rates, data from the engineering study must be transformed into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors, and flood insurance zone

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designations for each flooding source studied in detail in the Township of Parsippany-Troy Hills.

5.1 Reach Determinations

Reaches are defined as sections of flood plain that have relatively the same flood hazard, based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. This difference may not have a variation greater than that indicated in the following tabulation for more than 20 percent of the reach:

Average Difference Between 10- and 100-Year Floods	Variation
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 foot
7.1 to 12 feet	2.0 feet
More than 12 feet	3.0 feet

The locations of the reaches determined for the flooding sources of the Township of Parsippany-Troy Hills are shown on the Flood Profiles (Exhibit 1) and summarized in Table 3.

5.2 Flood Hazard Factors

The Flood Hazard Factor (FHF) is used to establish relationships between depth and frequency of flooding in any reach. This relationship is then used with depth-damage relationships for various classes of structures to establish actuarial insurance rate tables.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations rounded to the nearest one-half foot, multiplied by 10, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year flood water-surface elevations is greater than 10.0 feet, it is rounded to the nearest whole foot.

5.3 Flood Insurance Zones

Flood insurance zones and zone numbers are assigned based on the type of flood hazard and the FHF, respectively. A unique zone number is associated with each possible FHF, and varies from 1 for a FHF of 005 to a maximum of 30 for a FHF of 200 or greater.

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FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND			FHF	ZONE	BASE FLOOD ELEVATION[3] (NGVD)
		10% (10 YR.)	2% (50 YR.)	0.2% (500 YR.)			
Rockaway River							
Reach 1	05,09	-3.2	-1.1	+3.4	030	A6	Varies
Reach 2	04,05	-1.5	-0.5	+1.2	015	A3	Varies
Passaic River Flooding affecting Rockaway River	09,11	-3.2	-1.1	+3.4	030	A6	Varies
Flooding affecting Whippany River, Troy Brook, and West Brook	09,10,11	-2.4	-1.2	+1.2	025	A5	Varies
Troy Brook							
Reach 1	04,08,09 11	-1.3	-0.4	+1.2	015	A3	Varies
Reach 2	04	-2.2	-0.5	+1.0	020	A4	Varies

[1]Flood Insurance Rate Map Panel
[2]Weighted Average
[3]Rounded to the nearest foot - see map

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF PARSIPPANY - TROY HILLS, NJ
(MORRIS CO.)

FLOOD INSURANCE ZONE DATA

ROCKAWAY RIVER - PASSAIC RIVER - TROY BROOK

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FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND			FHF	ZONE	BASE FLOOD ELEVATION[3] (NGVD)
		10% (10 YR.)	2% (50 YR.)	0.2% (500 YR.)			
West Brook							
Reach 1	10	-0.8	-0.3	+0.8	010	A2	Varies
Eastmans Brook							
Reach 1	08	-1.0	-0.3	+0.7	010	A2	Varies
Watnong Brook							
Reach 1	03	-4.4	-1.6	+4.1	045	A9	Varies
Reach 2	03	-1.6	-1.1	+3.3	015	A3	Varies
Reach 3	03	-1.1	-0.4	+0.8	010	A2	Varies

[1]Flood Insurance Rate Map Panel
[2]Weighted Average
[3]Rounded to the nearest foot - see map

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF PARSIPPANY - TROY HILLS, NJ
(MORRIS CO.)

FLOOD INSURANCE ZONE DATA

WEST BROOK - EASTMANS BROOK - WATNONG BROOK

Zones A2, A3, A4, A5, A6, and A9: Special Flood Hazard Areas inundated by the 100-year flood; with base flood elevations shown, and zones subdivided according to FHFs.

Zone B: Areas between the Special Flood Hazard Areas and the limits of the 500-year flood; areas that are protected from the 100- or 500-year floods by dike, levee, or other water control structure; areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; and areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided.

Zone C: Areas of minimal flooding; not subdivided.

Flood elevation differences, FHFs, flood insurance zones, and base flood elevations for the flooding sources studied in detail in the community are shown in Table 3.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for the Township of Parsippany-Troy Hills is, for insurance purposes, the principal result of the Flood Insurance Study. This map contains the official delineation of flood insurance zones and base flood elevations. Base flood elevation lines show the locations of the expected whole-foot water-surface elevation of the base (100-year) flood. The base flood elevations and zone numbers are used by insurance agents, in conjunction with structure elevations and characteristics, to assign actuarial insurance rates to structures and contents insured under the National Flood Insurance Program.

6.0 OTHER STUDIES

Flood Insurance Studies have been completed for the Township of Montville, the Borough of Morris Plains, the Township of East Hanover, the Town of Boonton, and the Township of Denville (References 20, 21, 22, 23, and 24). The studies for Montville, East Hanover, Boonton, and Denville are currently being revised. After those revisions are completed, the studies mentioned above will be in complete agreement with this study for Parsippany-Troy Hills.

Other studies utilized in this Flood Insurance Study were Drainage Study, Morris County, New Jersey and "Hydraulic Analysis of the Rockaway River, Montville, Parsippany-Troy Hills Townships, Morris County, New Jersey" (References 11 and 25). These studies are in agreement with this study for Parsippany-Troy Hills.

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The Passaic River Report and supplement are the primary source of flood elevation information of the Passaic River Basin (References 9 and 10). This report includes flood studies for the Rockaway River within the Township of Boonton based on computations for the 1903 flood in the Passaic River Basin (recurrence interval of over 100 years). The report also presents profiles and flood delineations for a 50-year flood computed on the basis of rainfall-runoff parameters obtained from analyses of the 1903 flood, and for the Standard Project Flood as defined by the COE. This report is currently being revised by the COE, and the revised report will be in agreement with the data in this Flood Insurance Study (Reference 15).

7.0 LOCATION OF DATA

Information concerning the pertinent data used in preparation of this study can be obtained by contacting the Natural and Technological Hazards Division, Federal Emergency Management Agency, Regional Director, Region II Office, 26 Federal Plaza, Room 19-100, New York, New York 10278.

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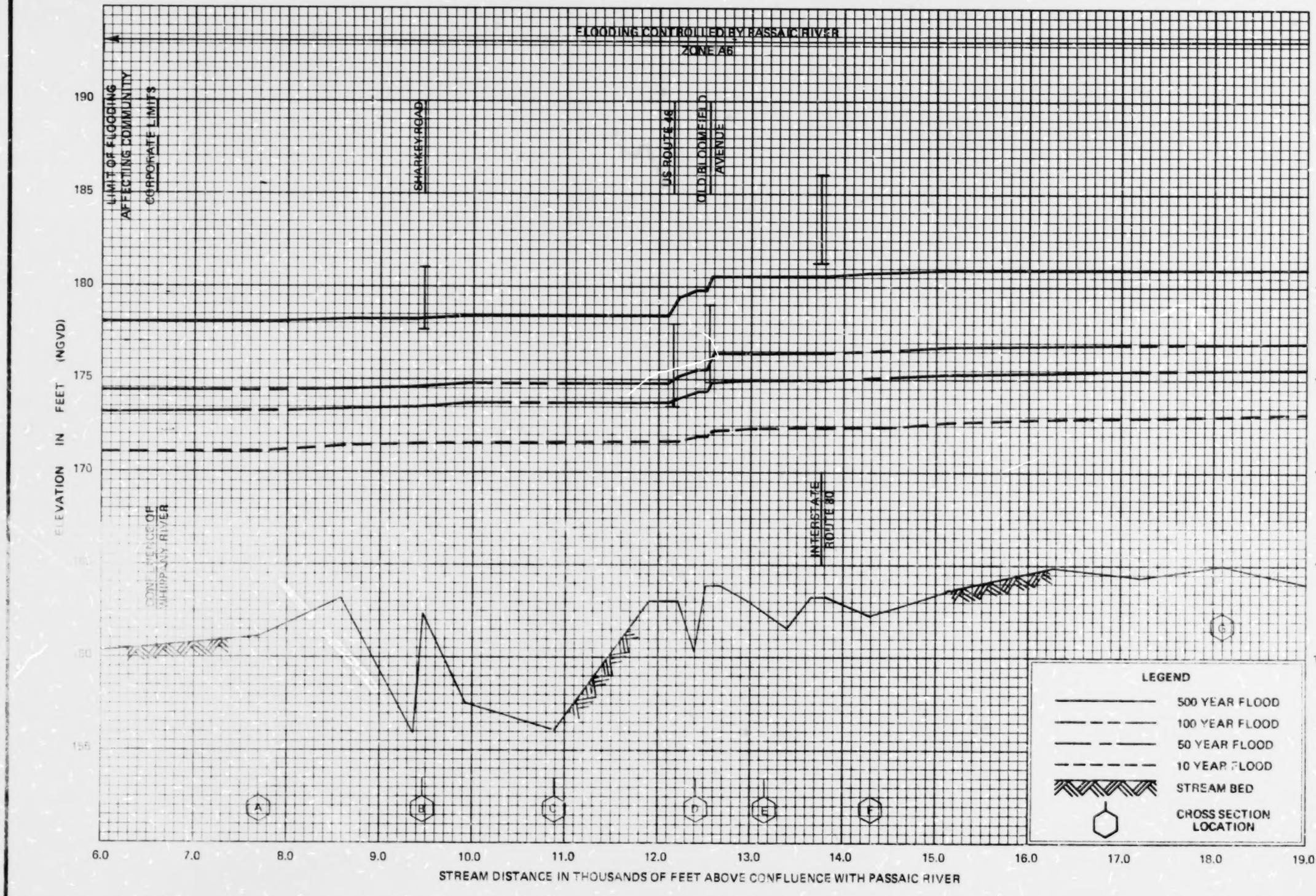

FLOOD PROFILES

ROCKAWAY RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF PARSIPPANY-TROY HILLS, NJ
(MORRIS CO.)

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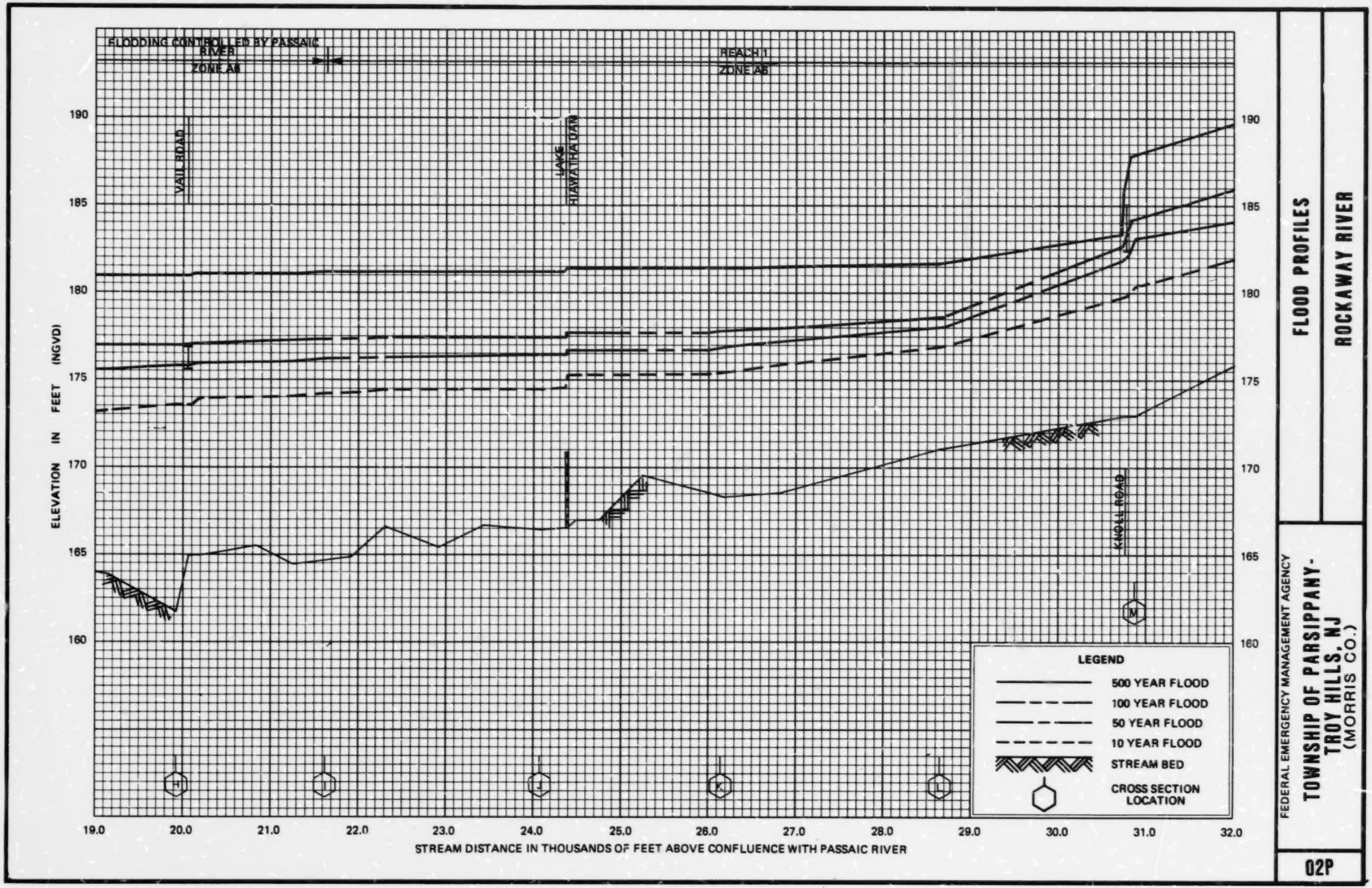

FLOOD PROFILES

ROCKAWAY RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF PARSIPPANY-TROY HILLS, NJ
(MORRIS CO.)

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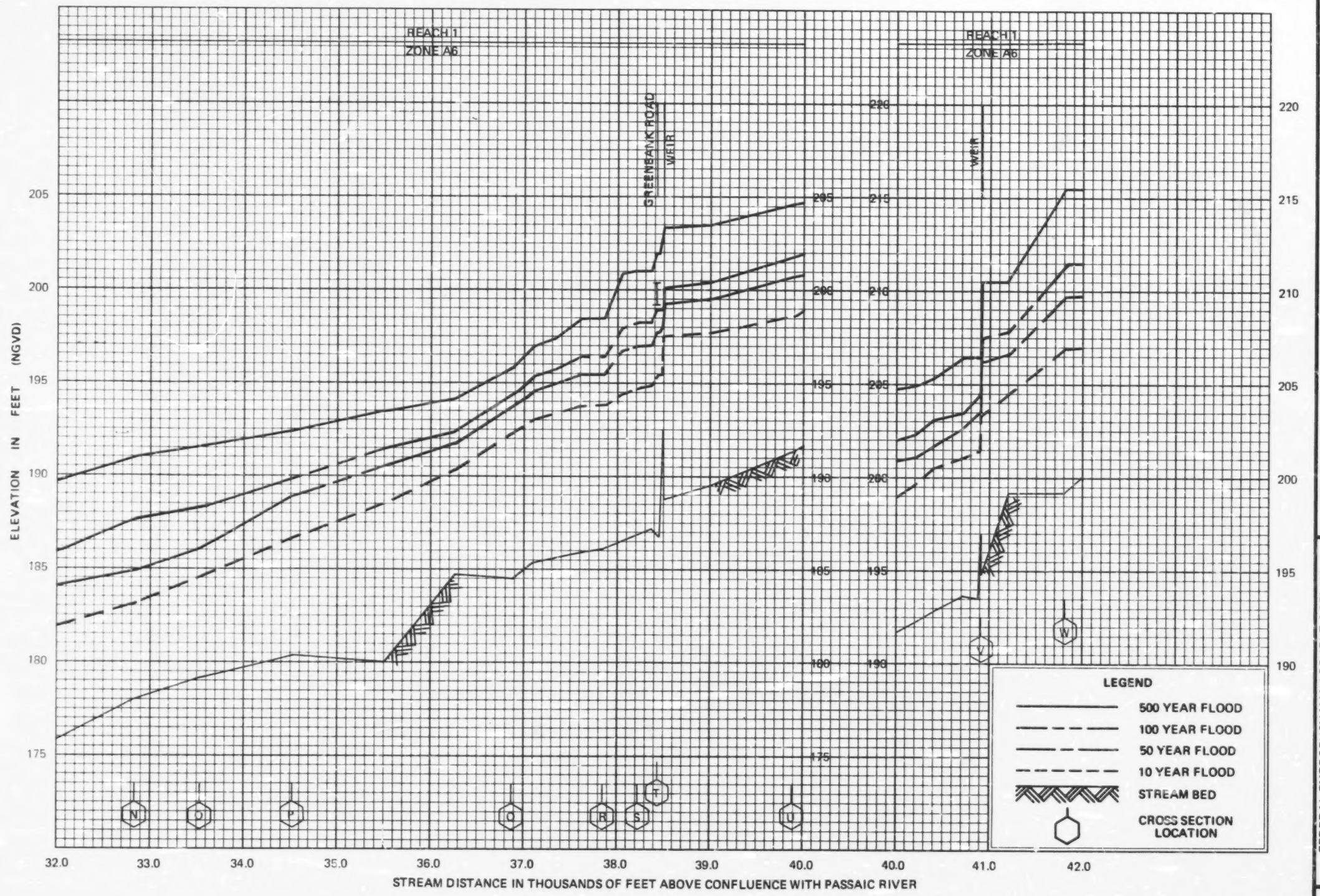

FLOOD PROFILES

ROCKAWAY RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF PARSIPPANY-TROY HILLS, NJ
(MORRIS CO.)

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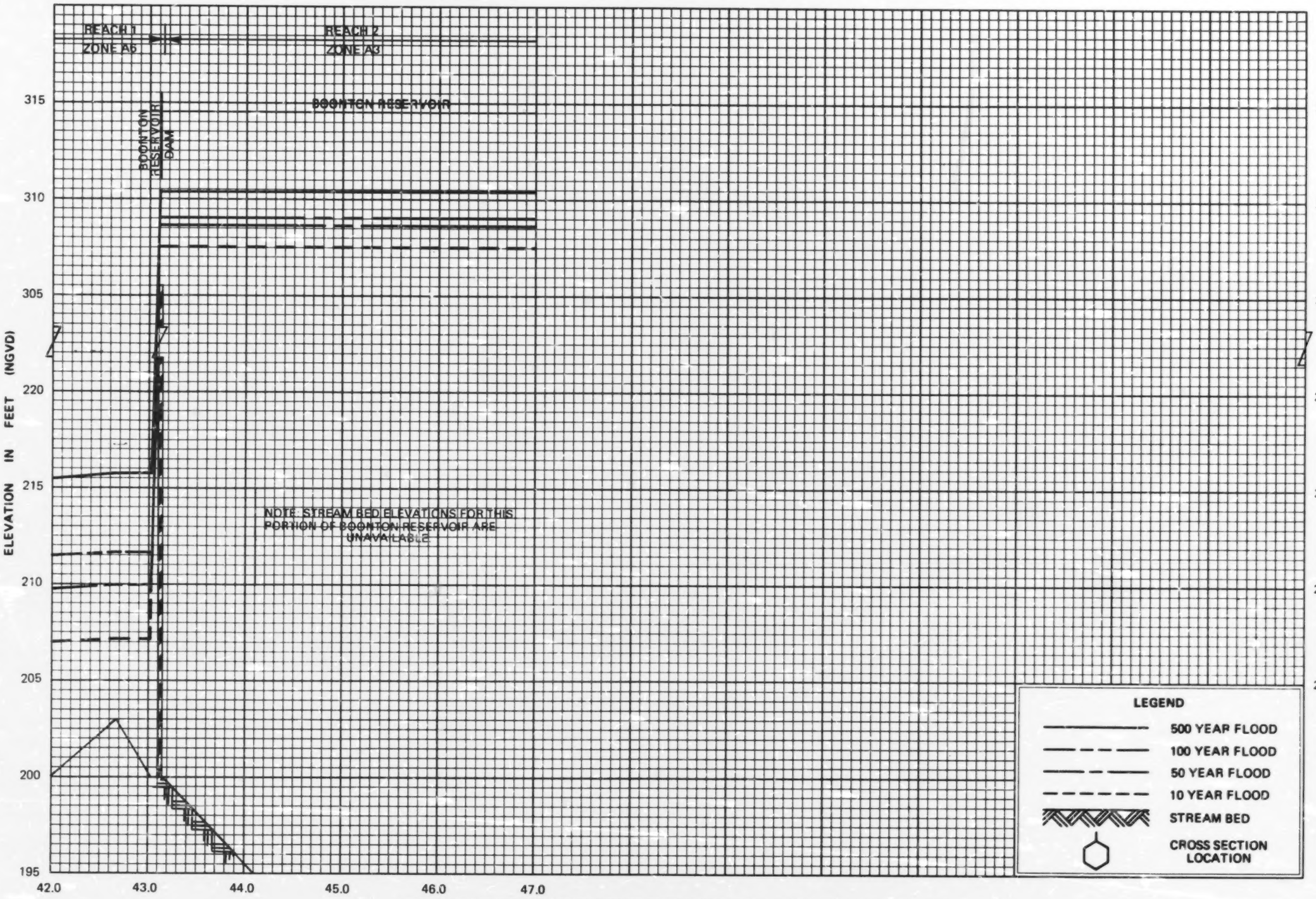

FLOOD PROFILES

ROCKAWAY RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF PARSIPPANY-TROY HILLS, NJ
(MORRIS CO.)

04P

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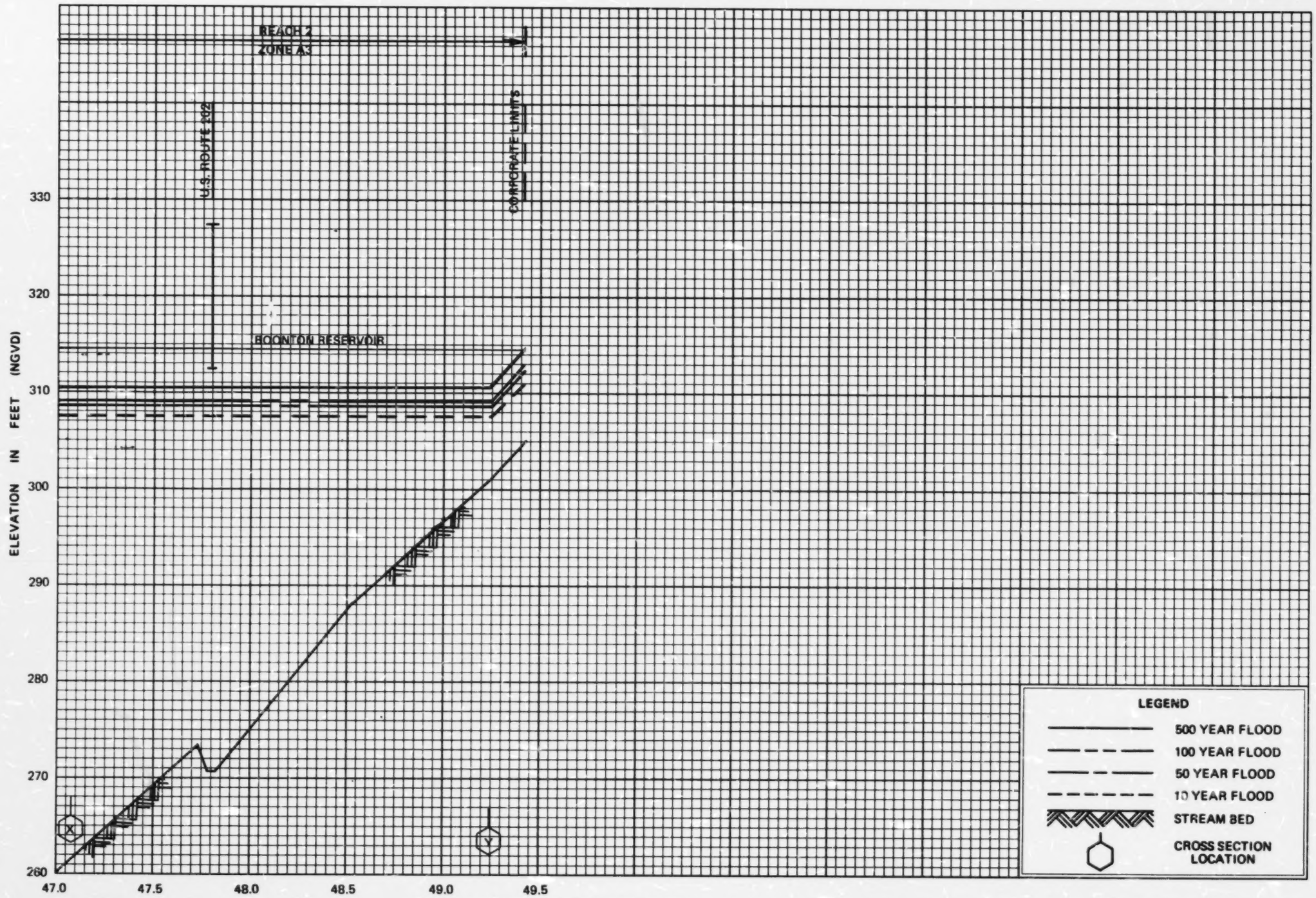

FLOOD PROFILES

ROCKAWAY RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF PARSIPPANY-TROY HILLS, NJ
(MORRIS CO.)

05P

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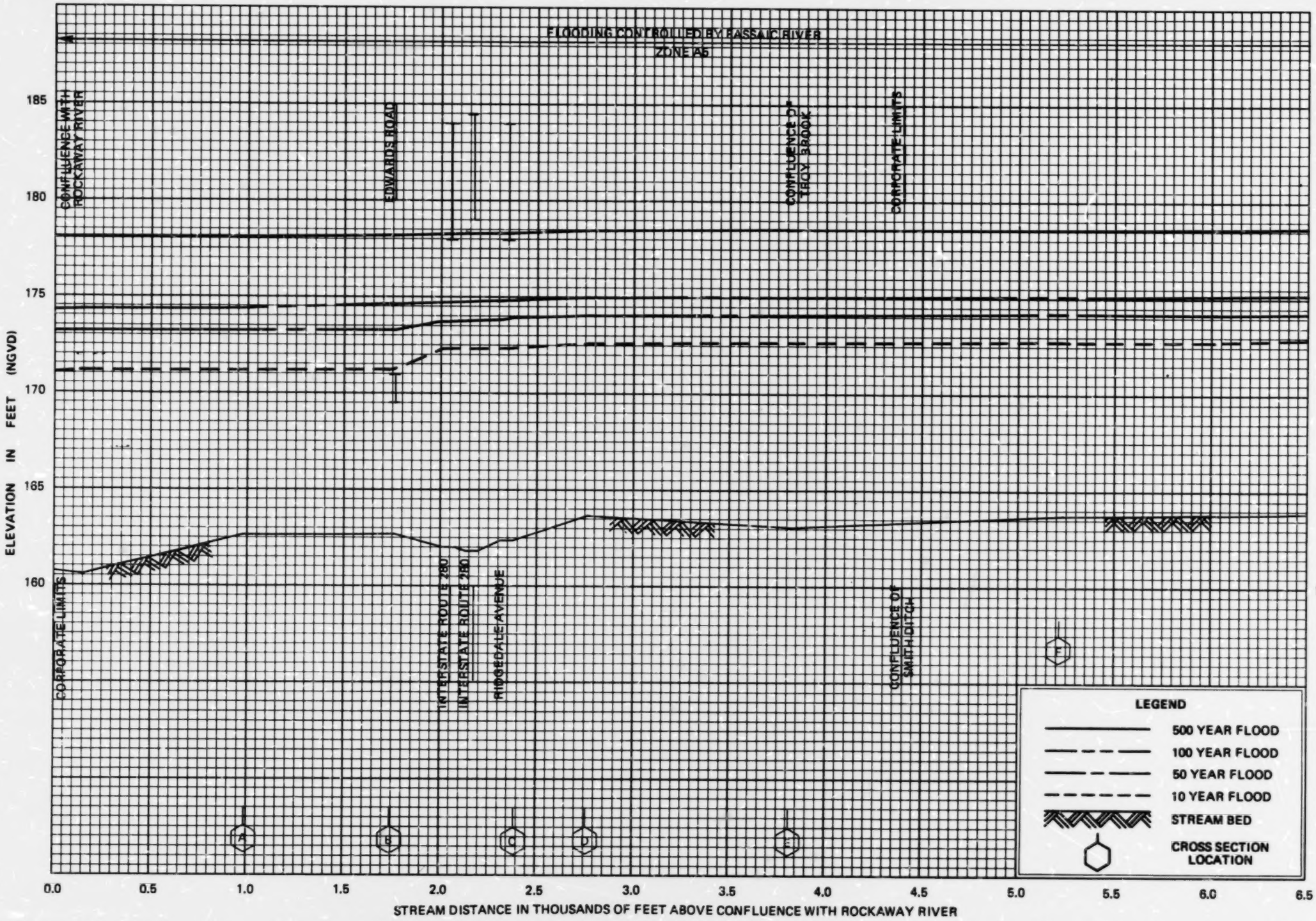

FLOOD PROFILES

WHIPPANY RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF PARSIPPANY-TROY HILLS, NJ
(MORRIS CO.)

06P

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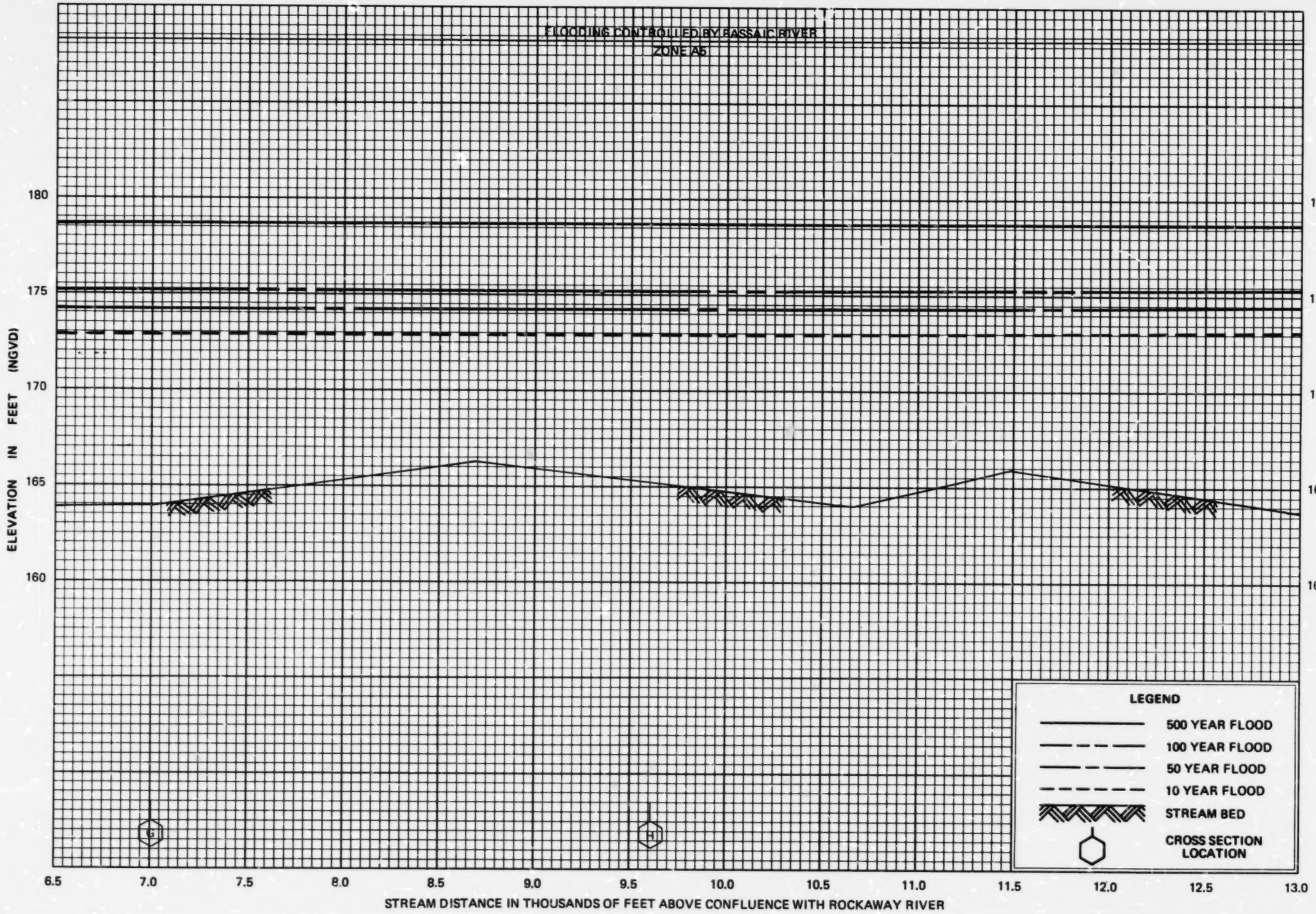

FLOOD PROFILES

WHIPPANY RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF PARSIPPANY-TROY HILLS, NJ
(MORRIS CO.)

07P

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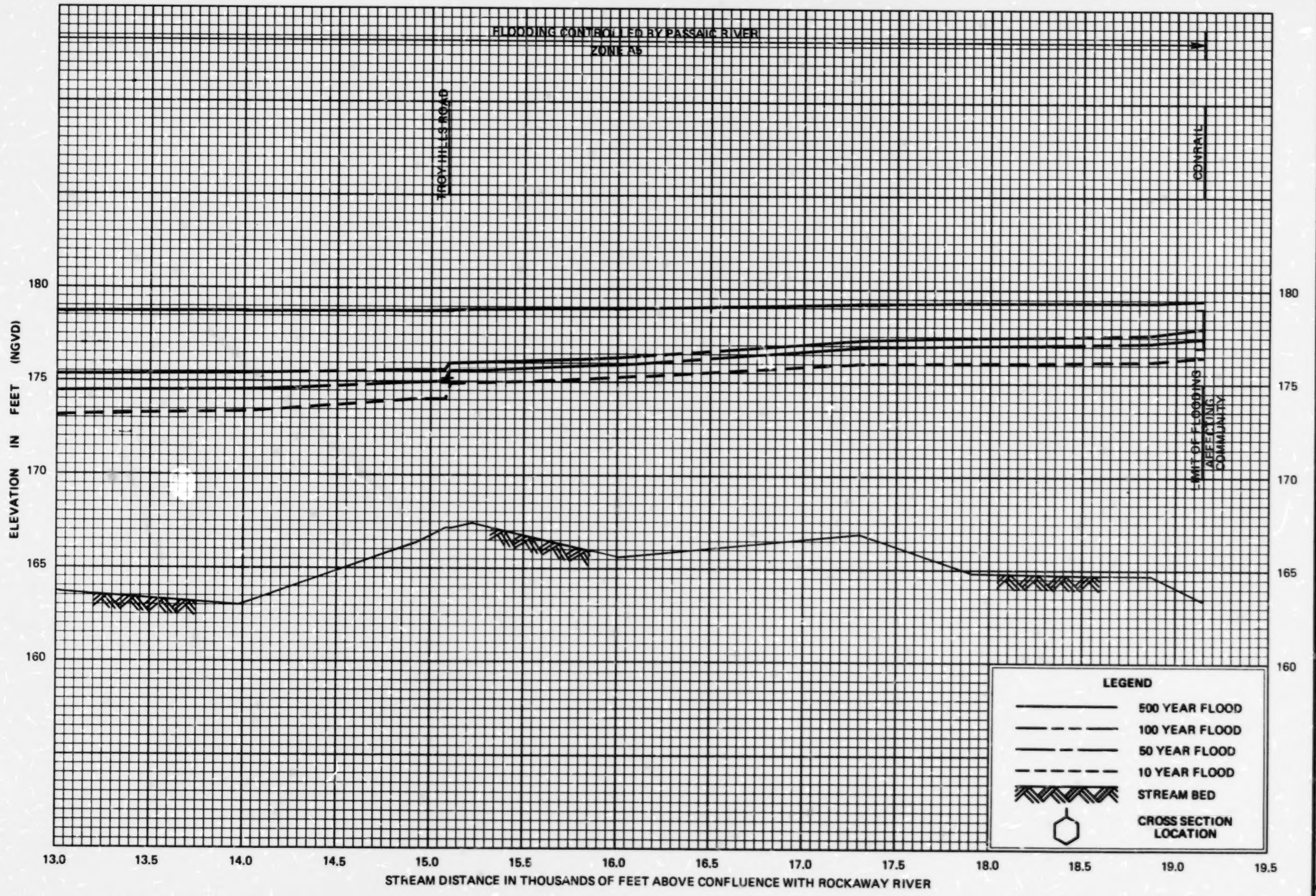

FLOOD PROFILES

WHIPPANY RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF PARSIPPANY-TROY HILLS, NJ
(MORRIS CO.)

08P

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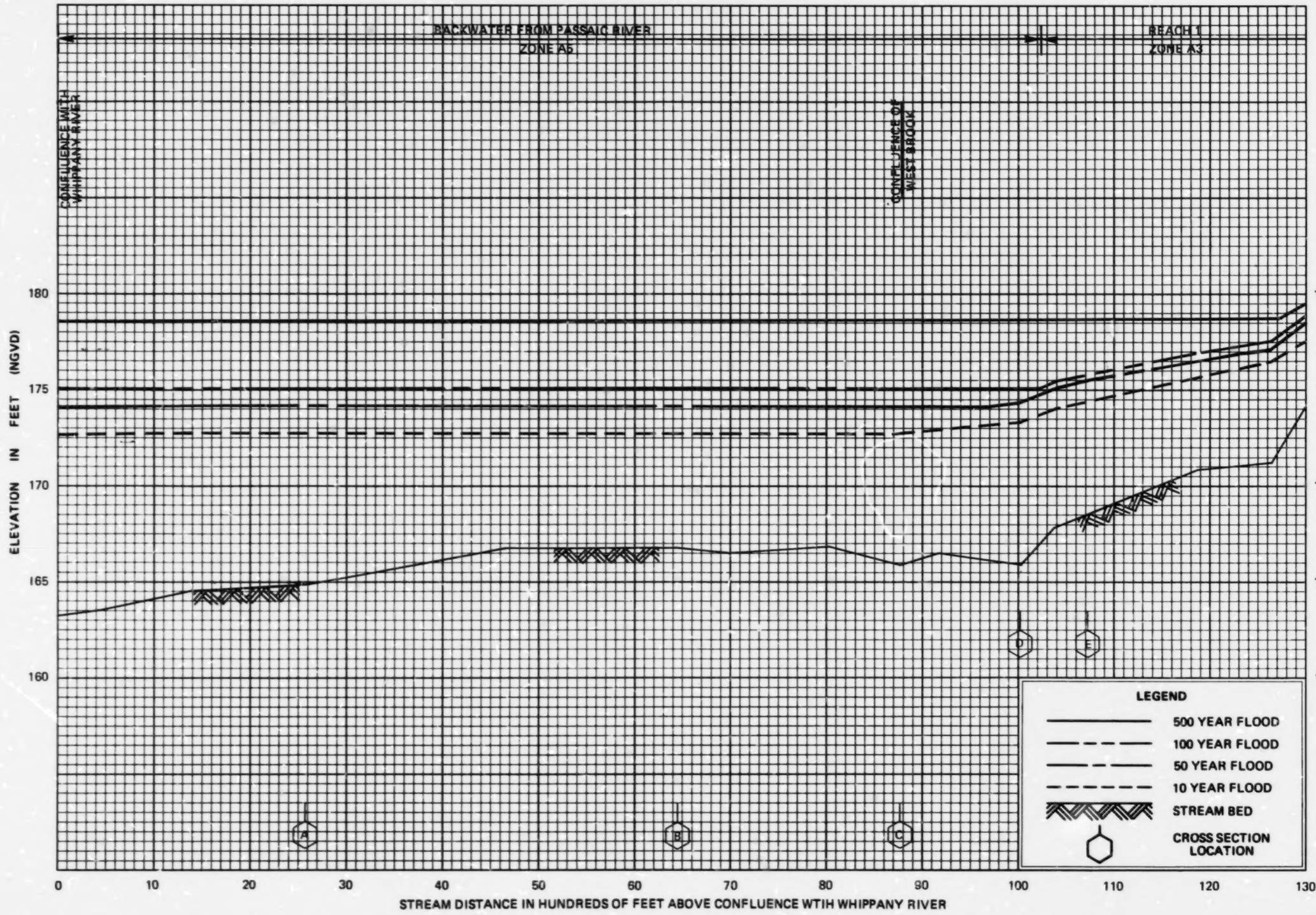

FLOOD PROFILES

TROY BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF PARSIPPANY-TROY HILLS, NJ
(MORRIS CO.)

09P

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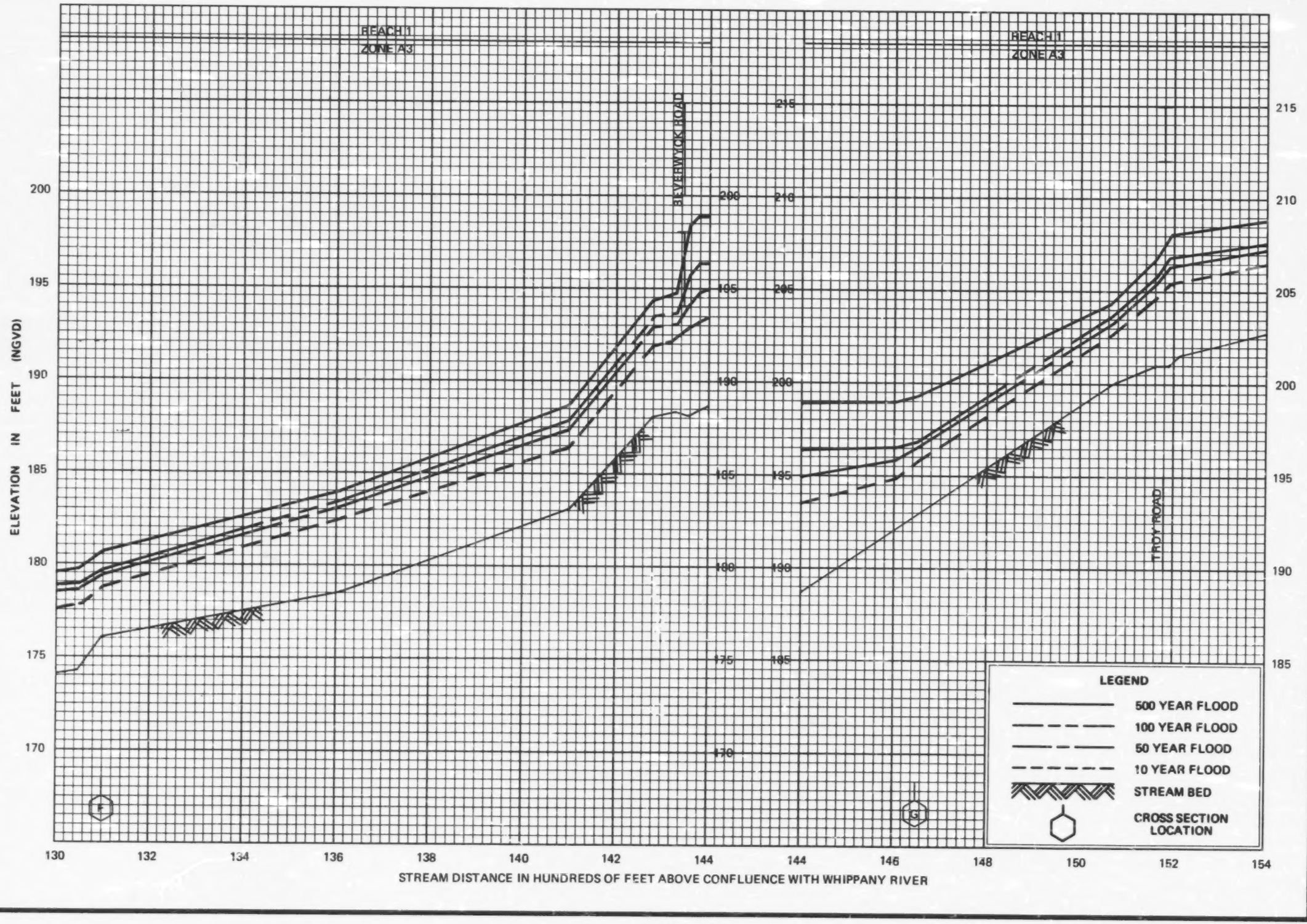

FLOOD PROFILES

TROY BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF PARSIPPANY-TROY HILLS, NJ
(MORRIS CO.)

10P

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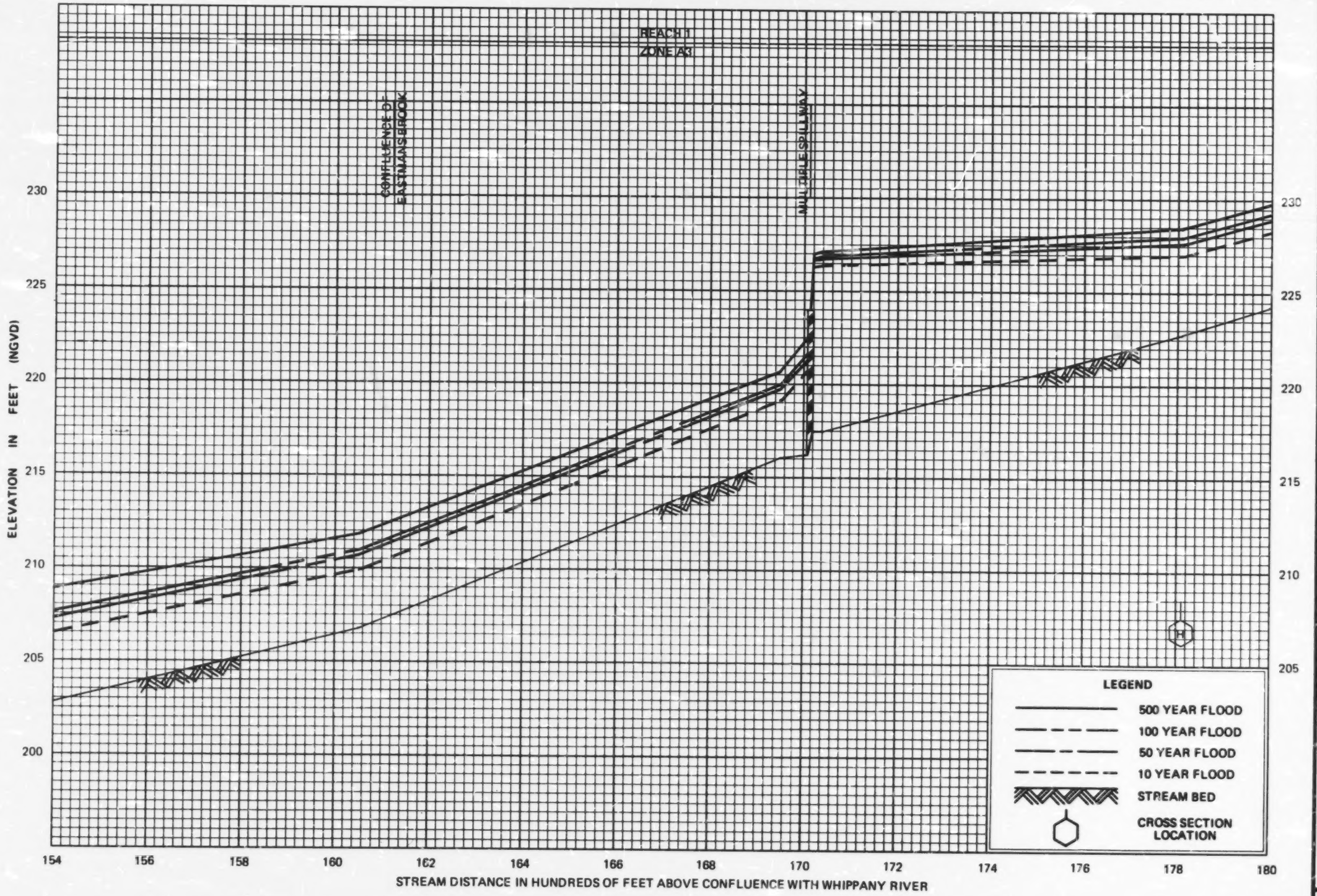

FLOOD PROFILES

TROY BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF PARSIPPANY-TROY HILLS, NJ
(MORRIS CO.)

11P

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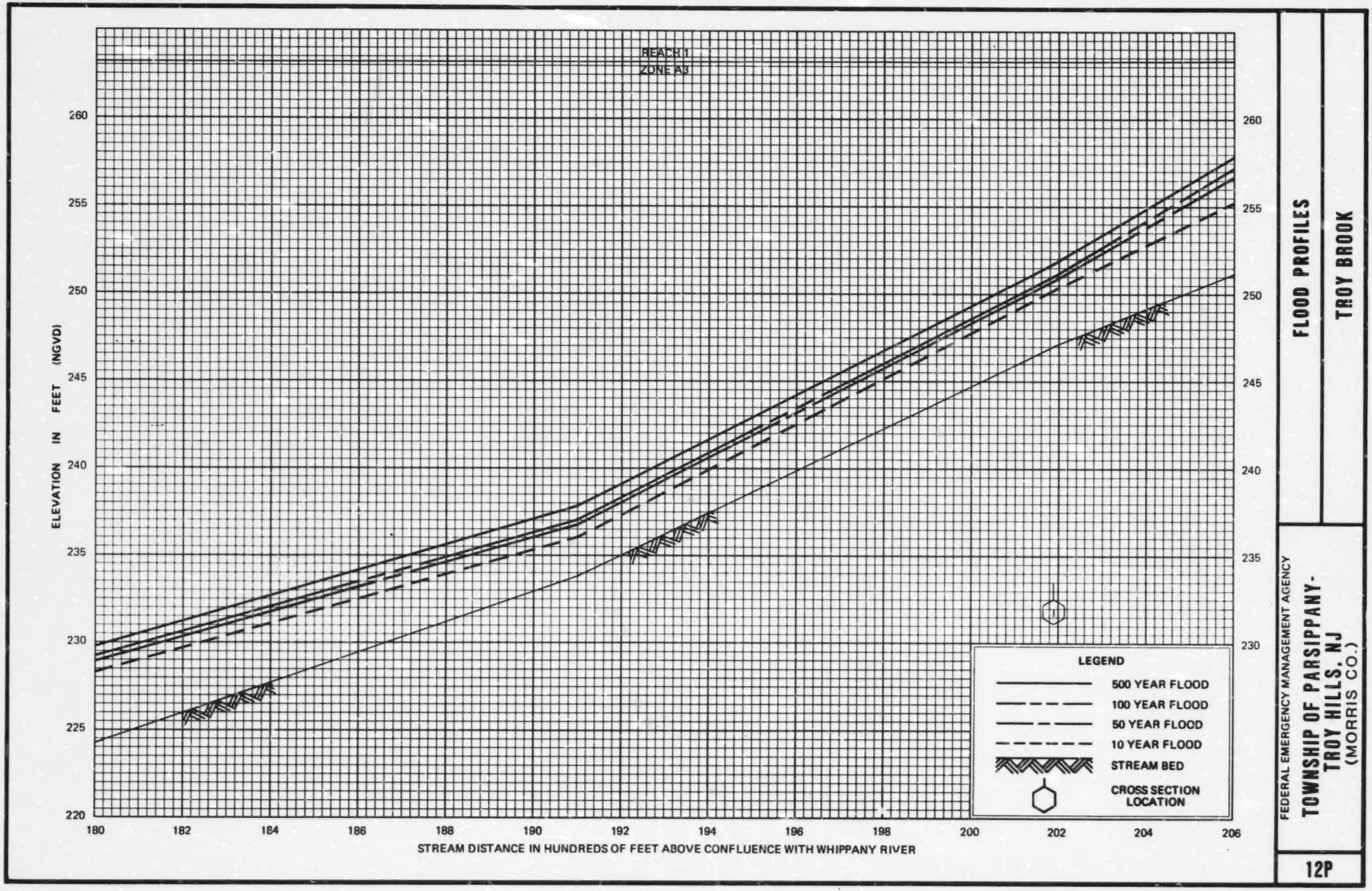

FLOOD PROFILES

TROY BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF PARSIPPANY-TROY HILLS, NJ
(MORRIS CO.)

12P

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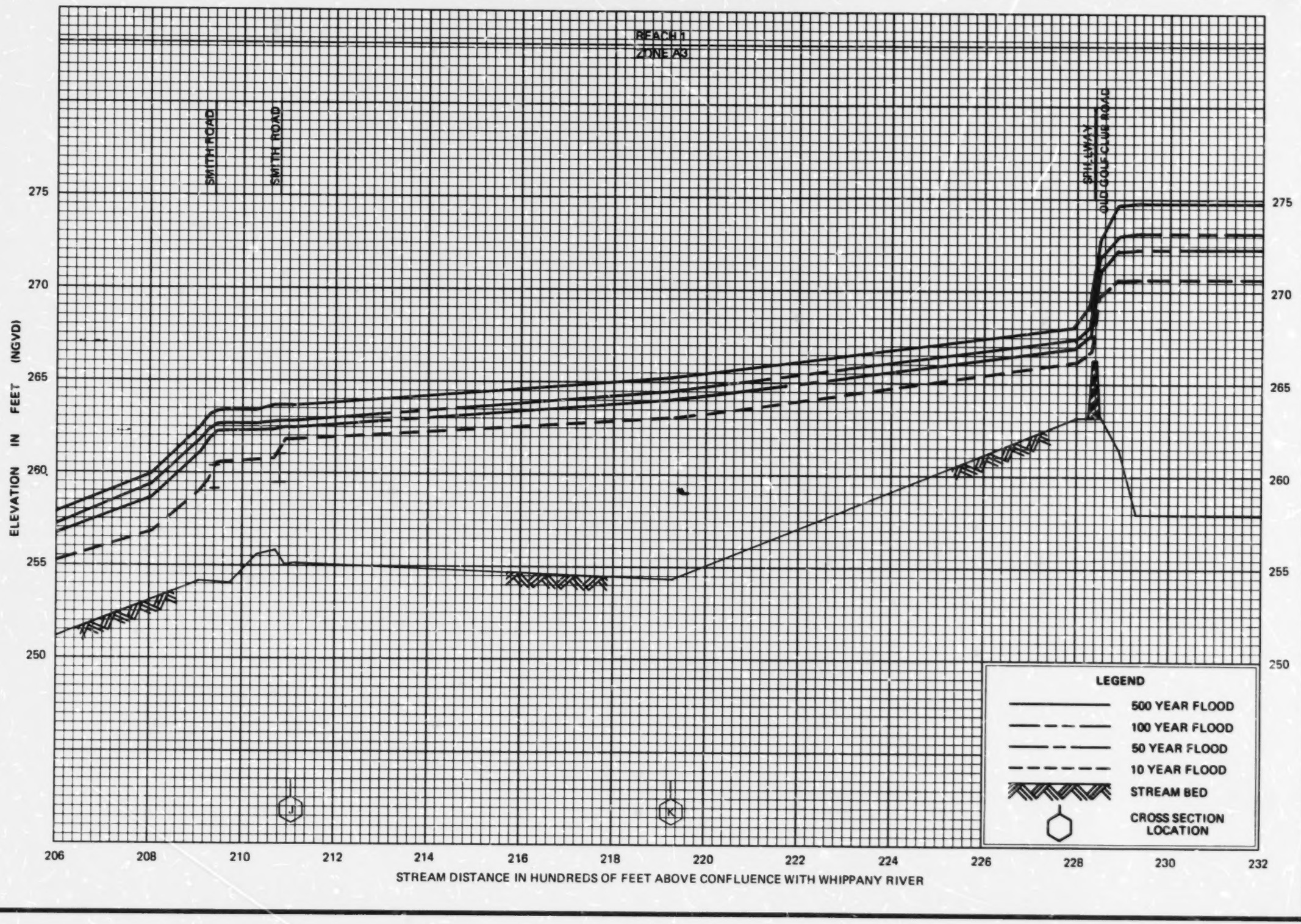

FLOOD PROFILES

TROY BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF PARSIPPANY-TROY HILLS, NJ
(MORRIS CO.)

13P

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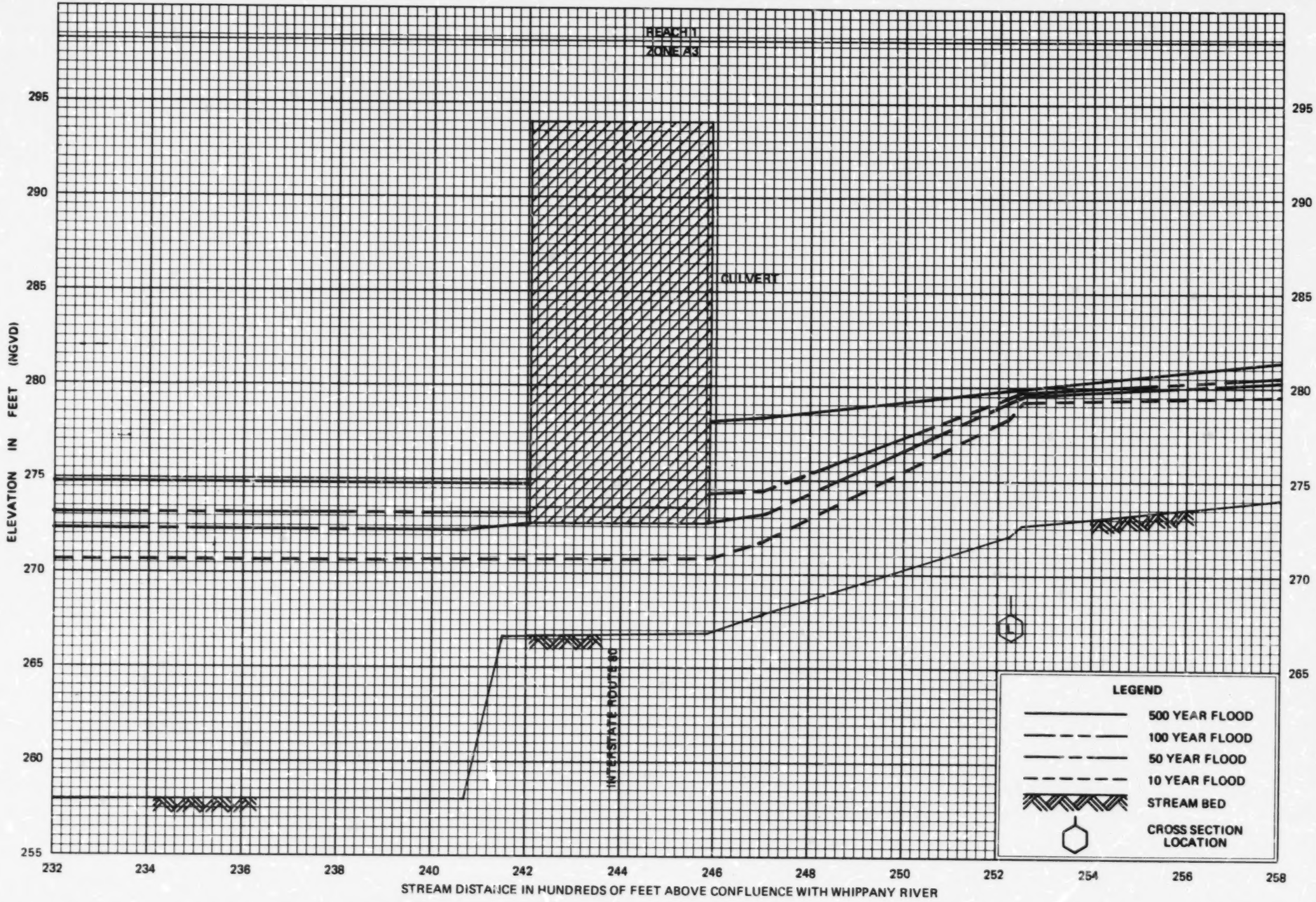

FLOOD PROFILES

TROY BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF PARSIPPANY-TROY HILLS, NJ
(MORRIS CO.)

14P

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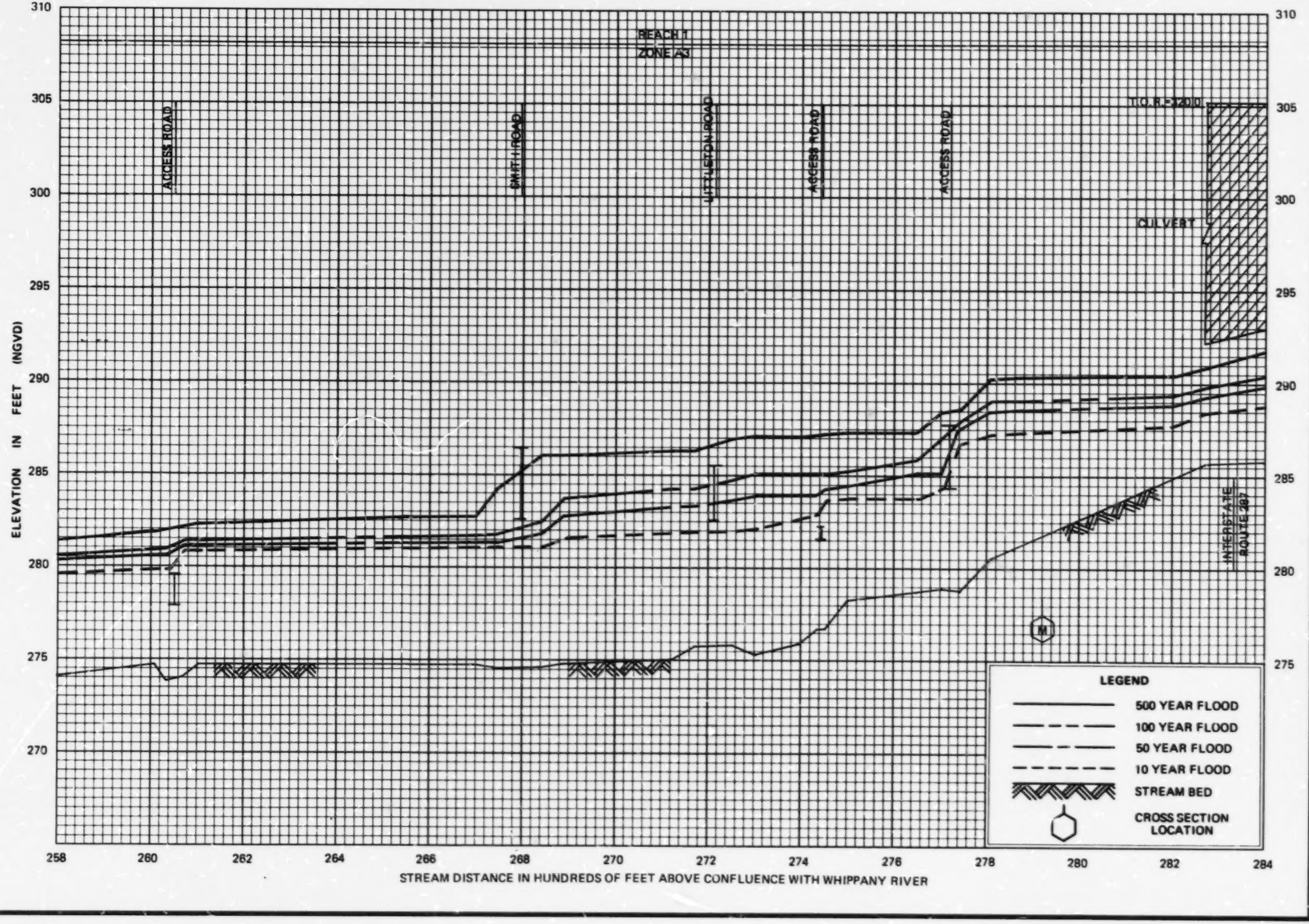

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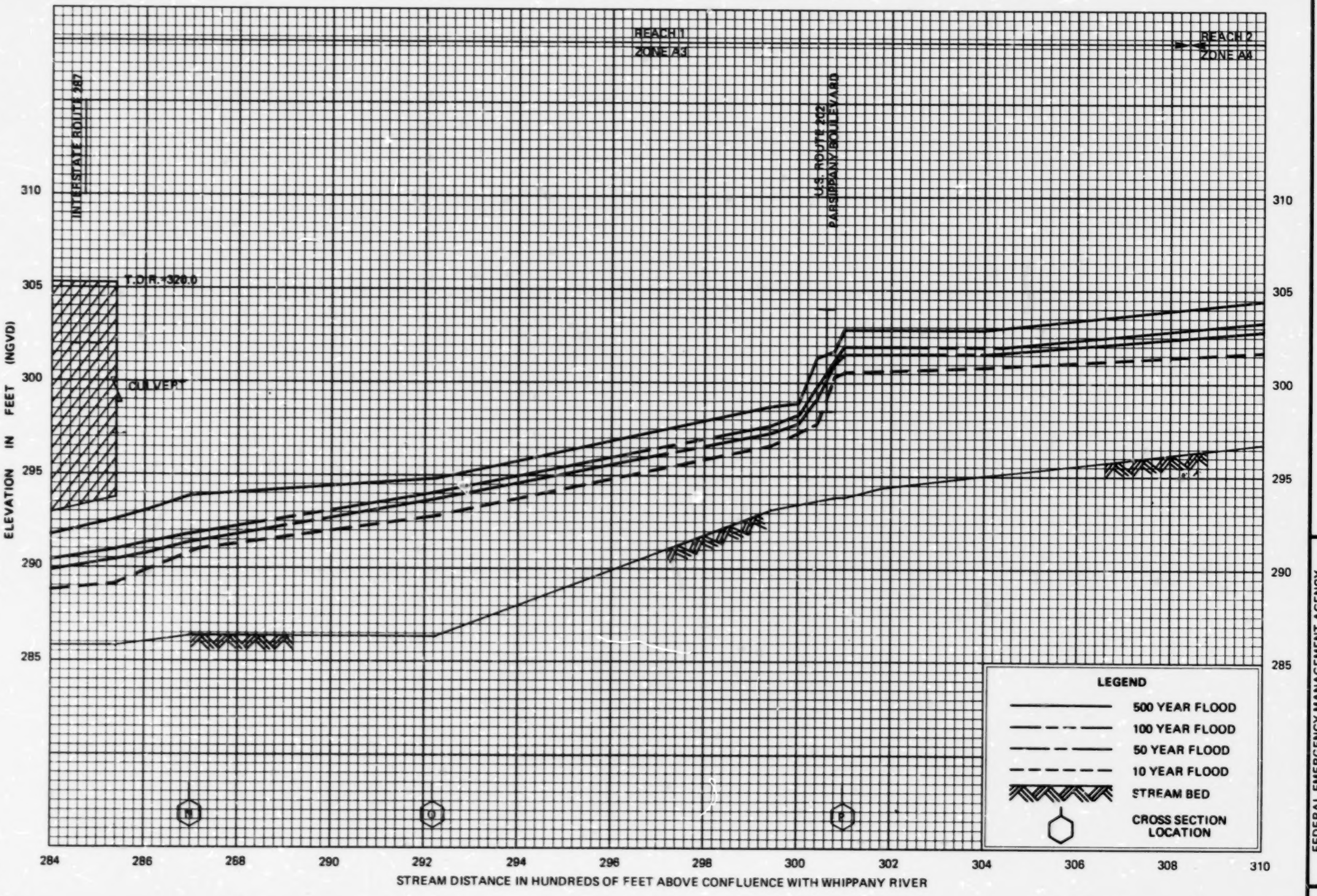

FLOOD PROFILES

TROY BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF PARSIPPANY-TROY HILLS, NJ
(MORRIS CO.)

16P

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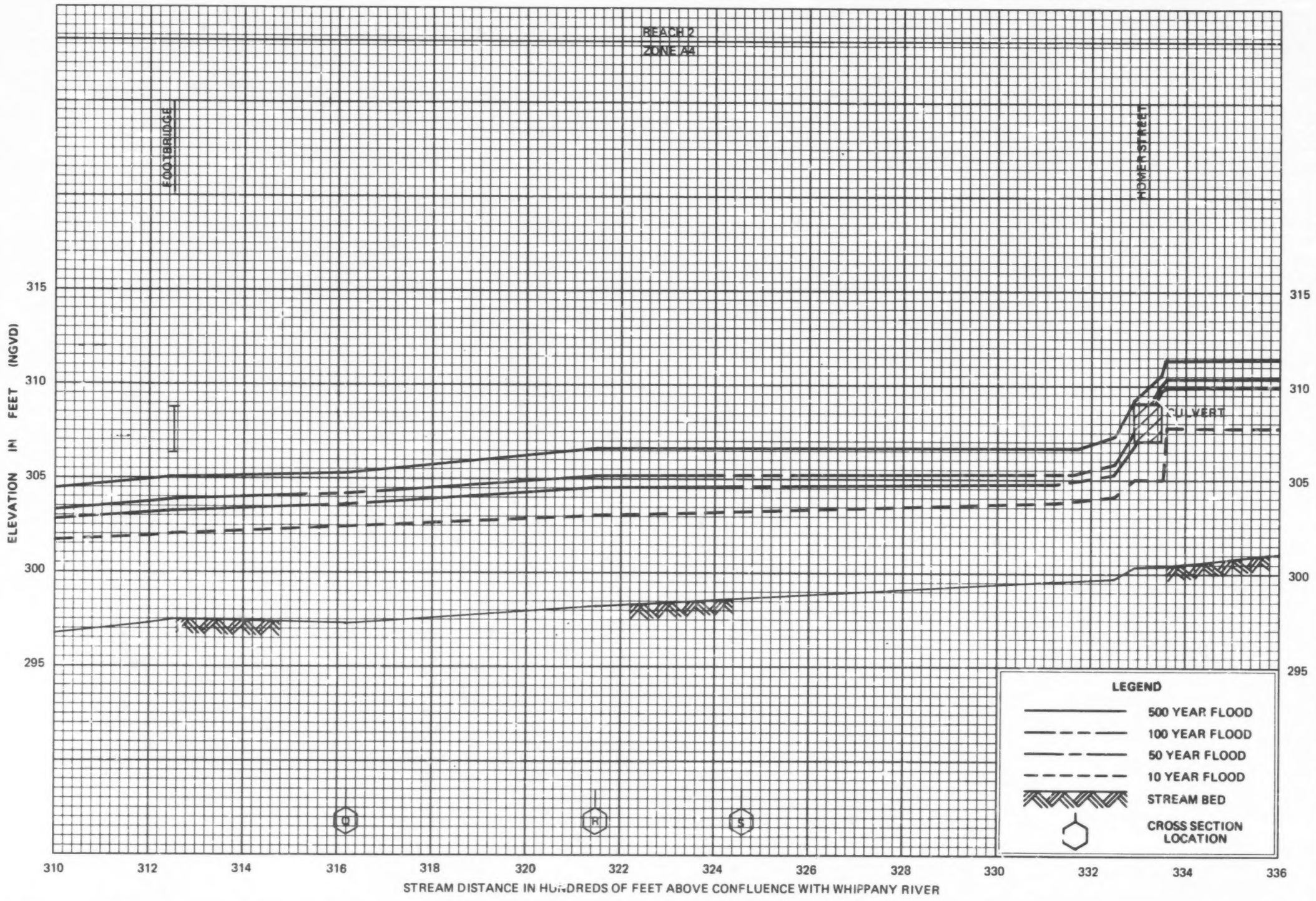

FLOOD PROFILES

TROY BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF PARSIPPANY-TROY HILLS, NJ
(MORRIS CO.)

17P

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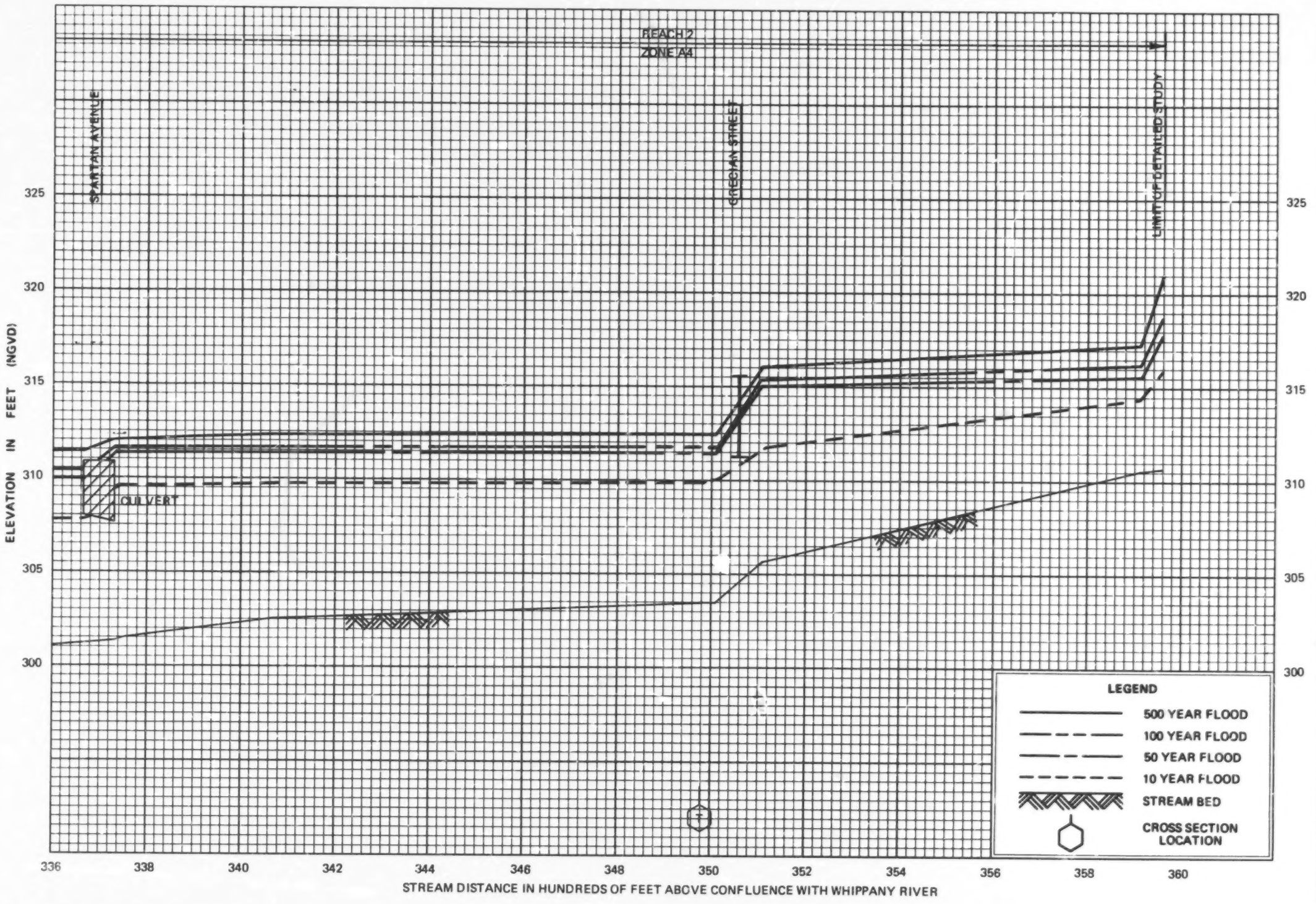

FLOOD PROFILES

TROY BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF PARSIPPANY-TROY HILLS, NJ
(MORRIS CO.)

18P

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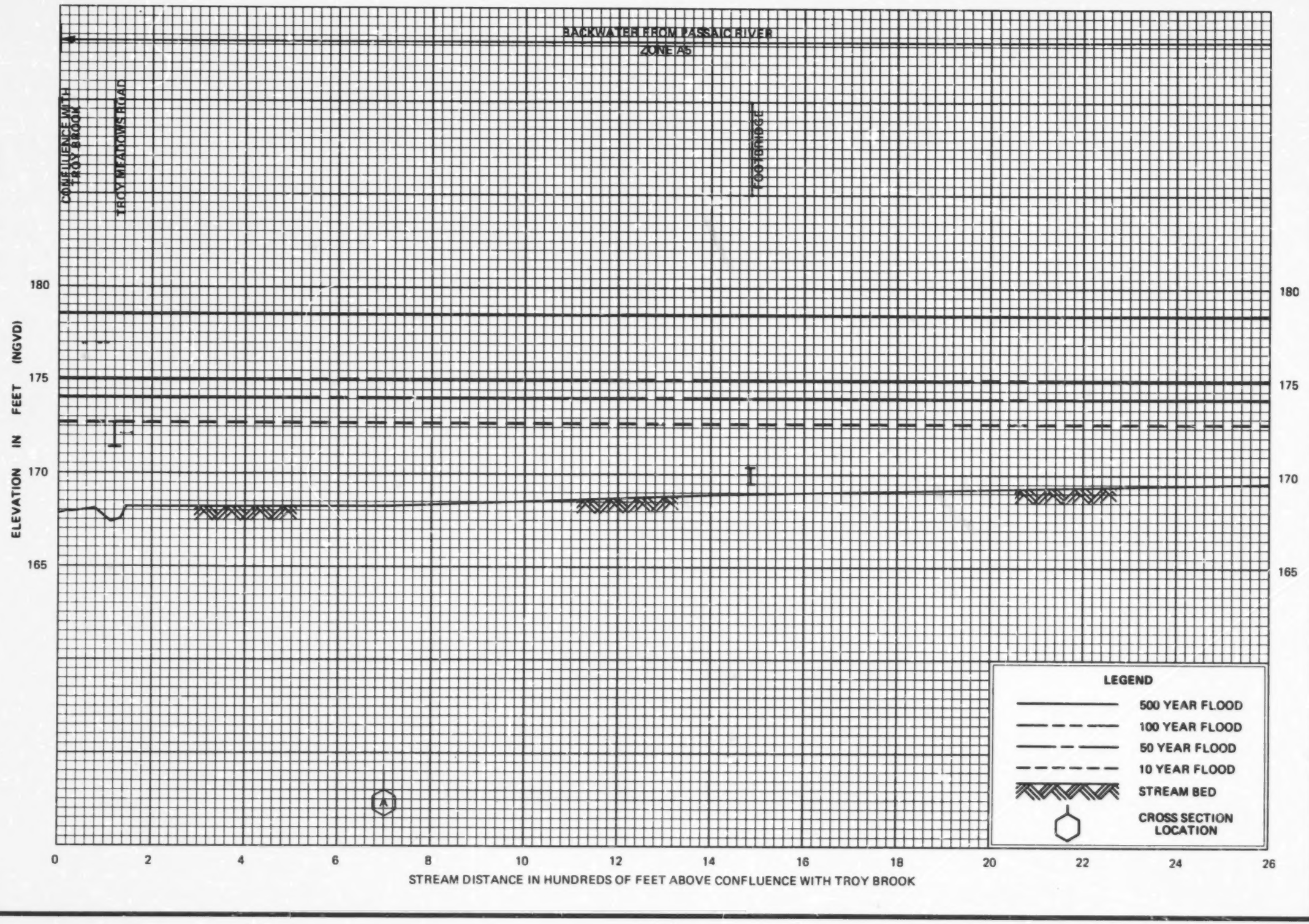

FLOOD PROFILES

WEST BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF PARSIPPANY-TROY HILLS, NJ
(MORRIS CO.)

19P

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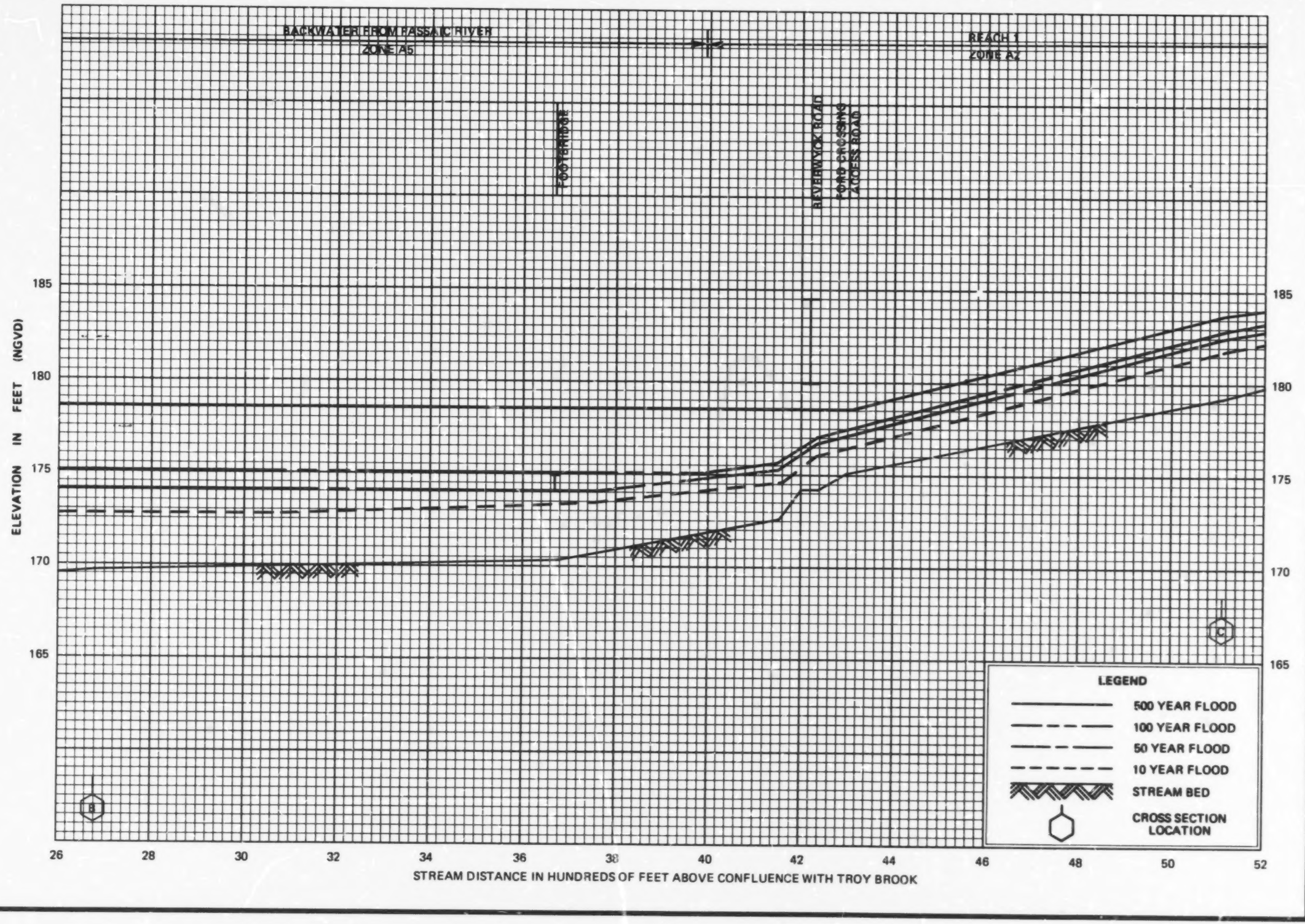

FLOOD PROFILES

WEST BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF PARSIPPANY-TROY HILLS, NJ
(MORRIS CO.)

20P

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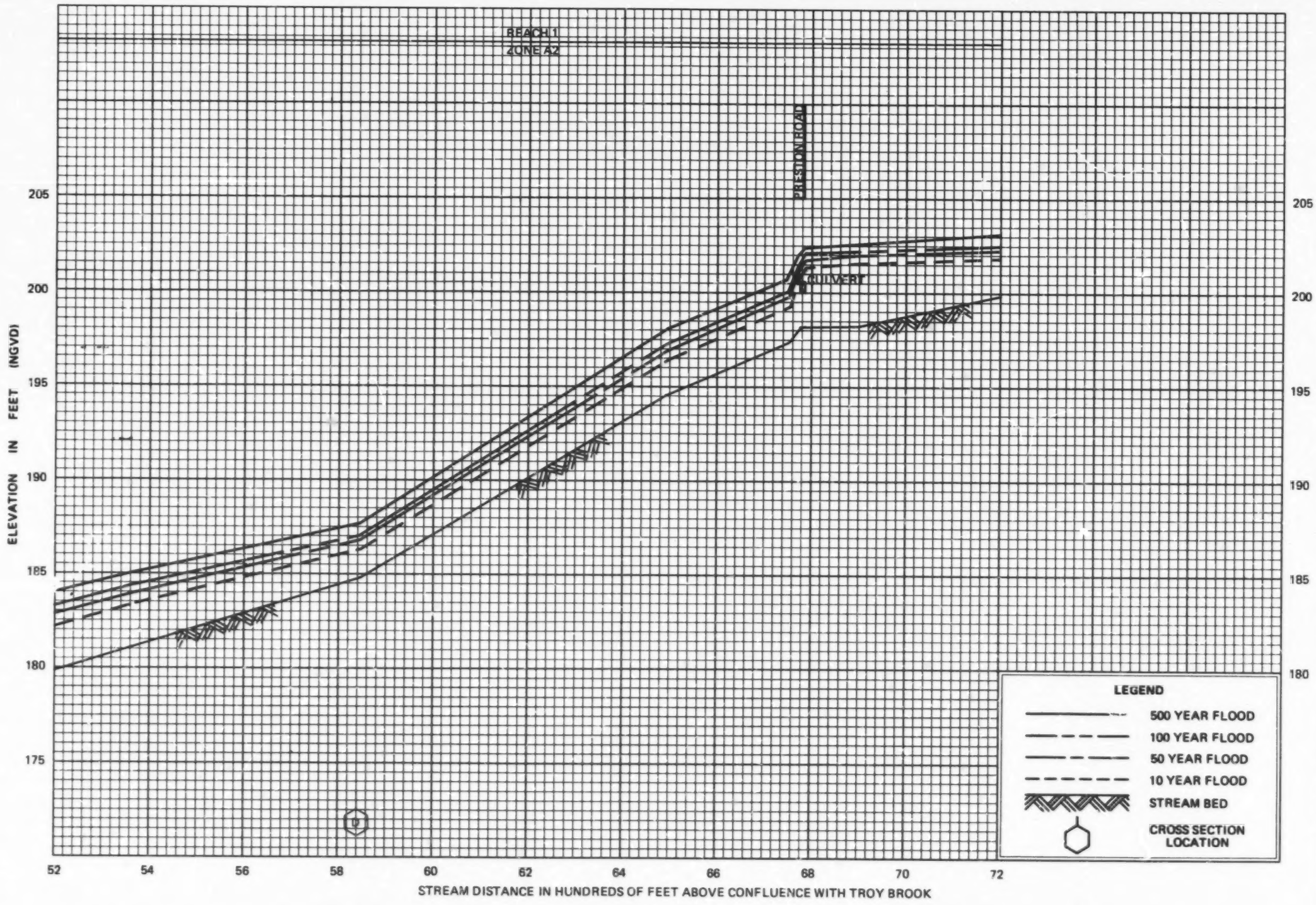

FLOOD PROFILES

WEST BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY
TOWNSHIP OF PARSIPPANY-TROY HILLS, NJ
(MORRIS CO.)

21P

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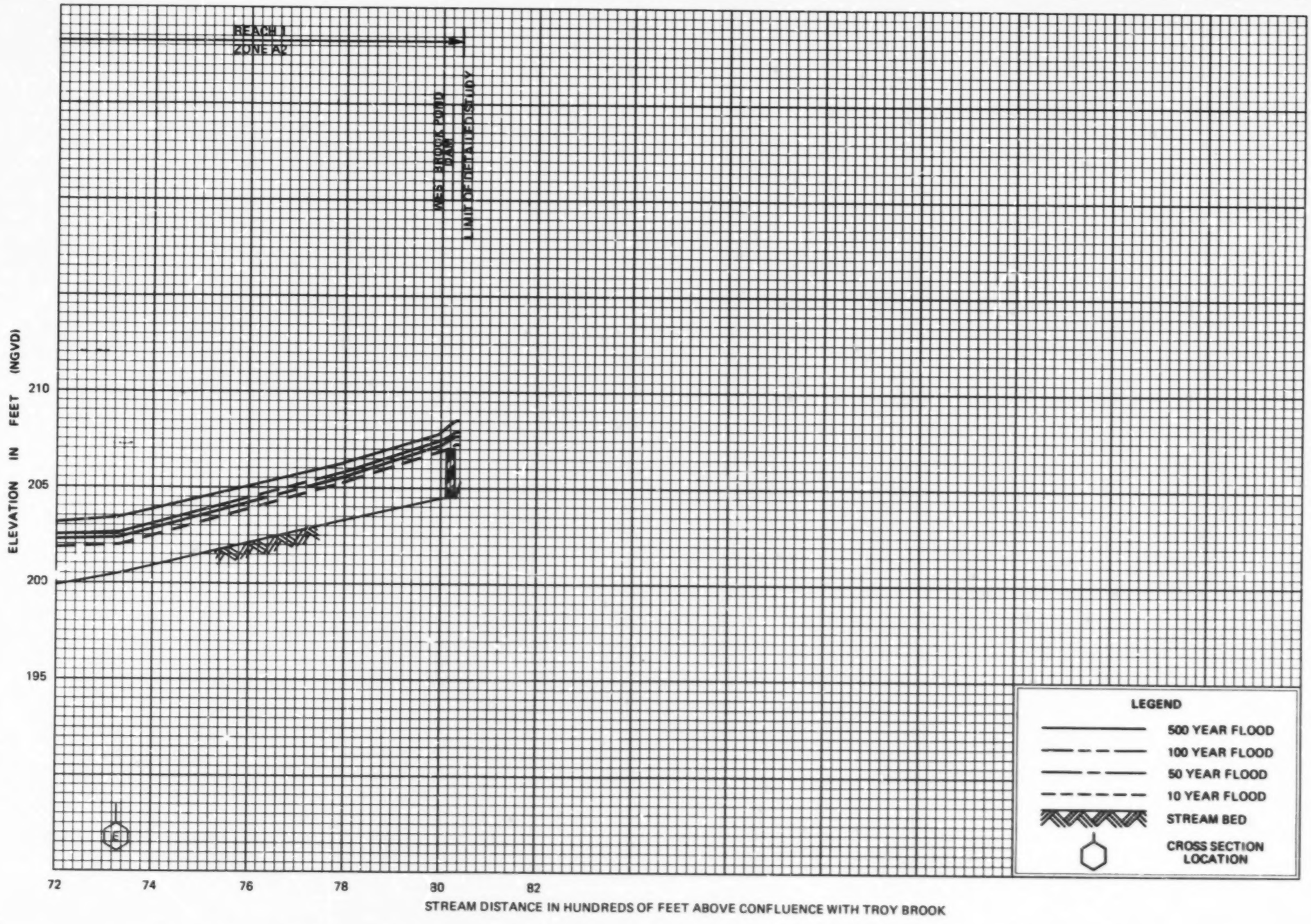

FLOOD PROFILES

WEST BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY
TOWNSHIP OF PARSIPPANY-TROY HILLS, NJ
(MORRIS CO.)

22P

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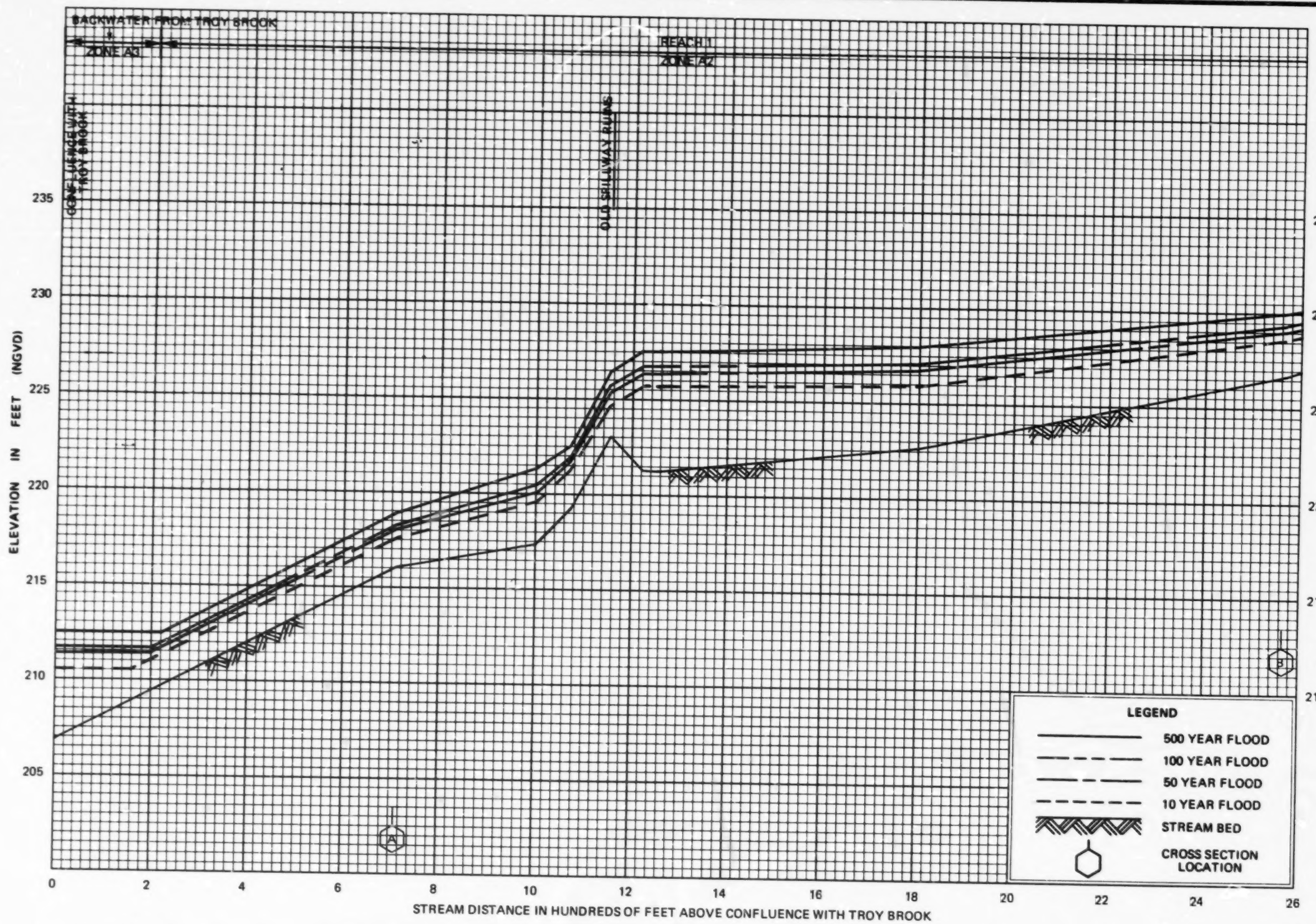

FLOOD PROFILES

EASTMANS BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF PARSIPPANY-TROY HILLS, NJ
(MORRIS CO.)

23P

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REACH 1
ZONE A2

SMITH ROAD

ELEVATION IN FEET (NGVD)

245
240
235
230
225

26 28 30 32 34 36 38 40 42 44 46 48 50 52

STREAM DISTANCE IN HUNDREDS OF FEET ABOVE CONFLUENCE WITH TROY BROOK

LEGEND
- 500 YEAR FLOOD
- 100 YEAR FLOOD
- 50 YEAR FLOOD
- 10 YEAR FLOOD
- STREAM BED
- CROSS SECTION LOCATION

FLOOD PROFILES

EASTMANS BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF PARSIPPANY-TROY HILLS, NJ
(MORRIS CO.)

24P

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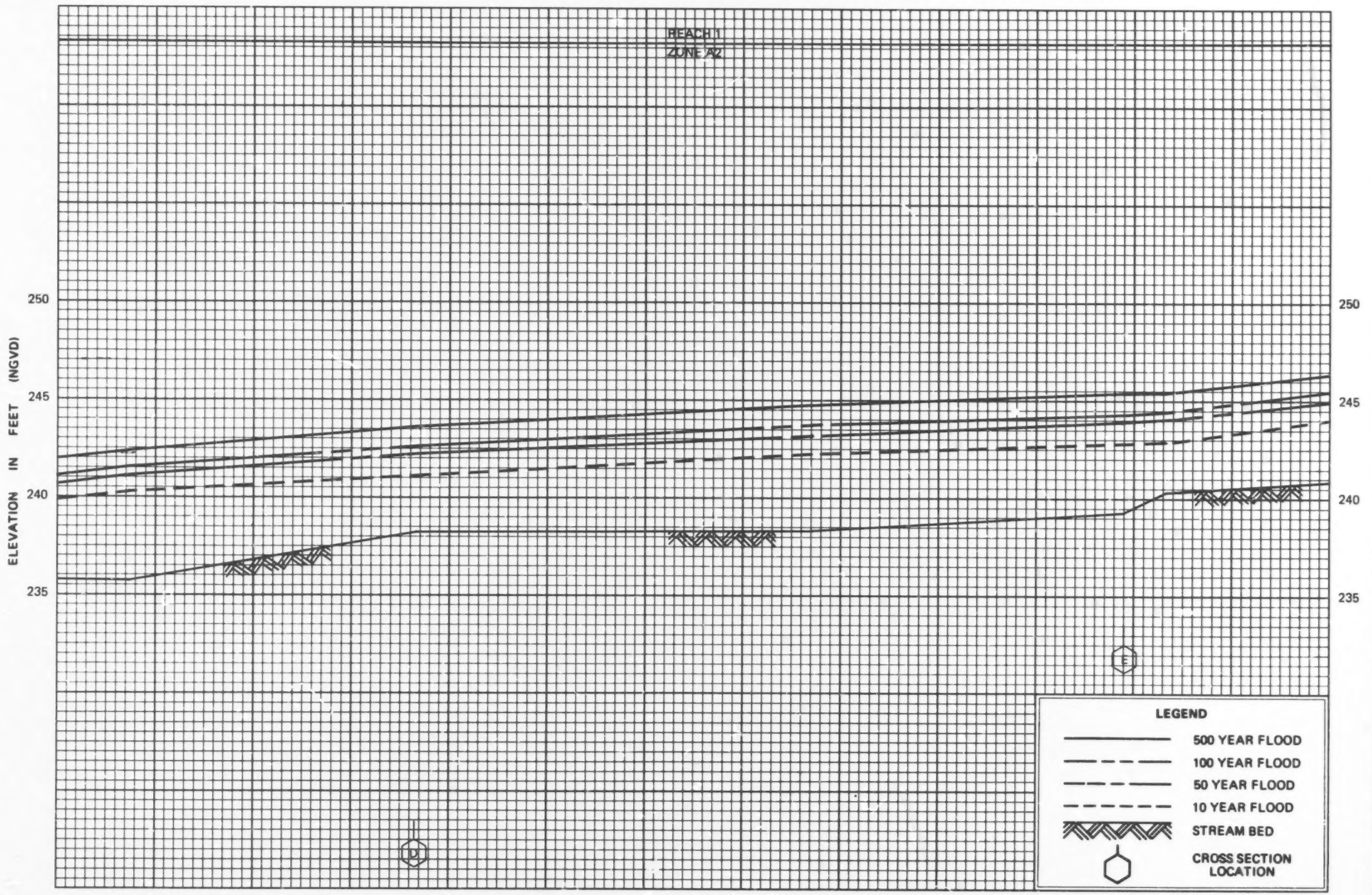

FLOOD PROFILES

EASTMANS BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF PARSIPPANY-TROY HILLS, NJ
(MORRIS CO.)

25P

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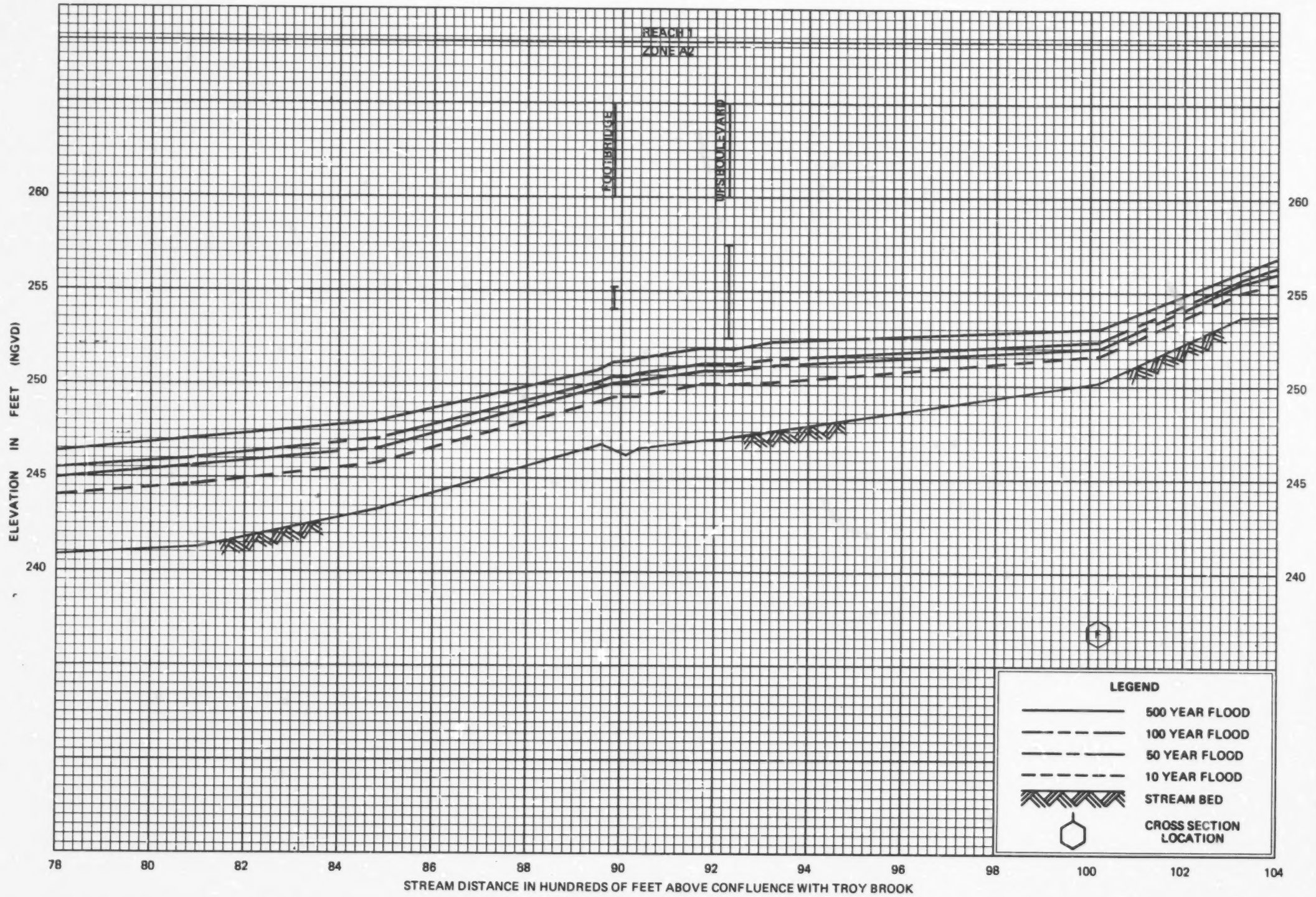

FLOOD PROFILES

EASTMANS BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF PARSIPPANY-TROY HILLS, NJ
(MORRIS CO.)

26P

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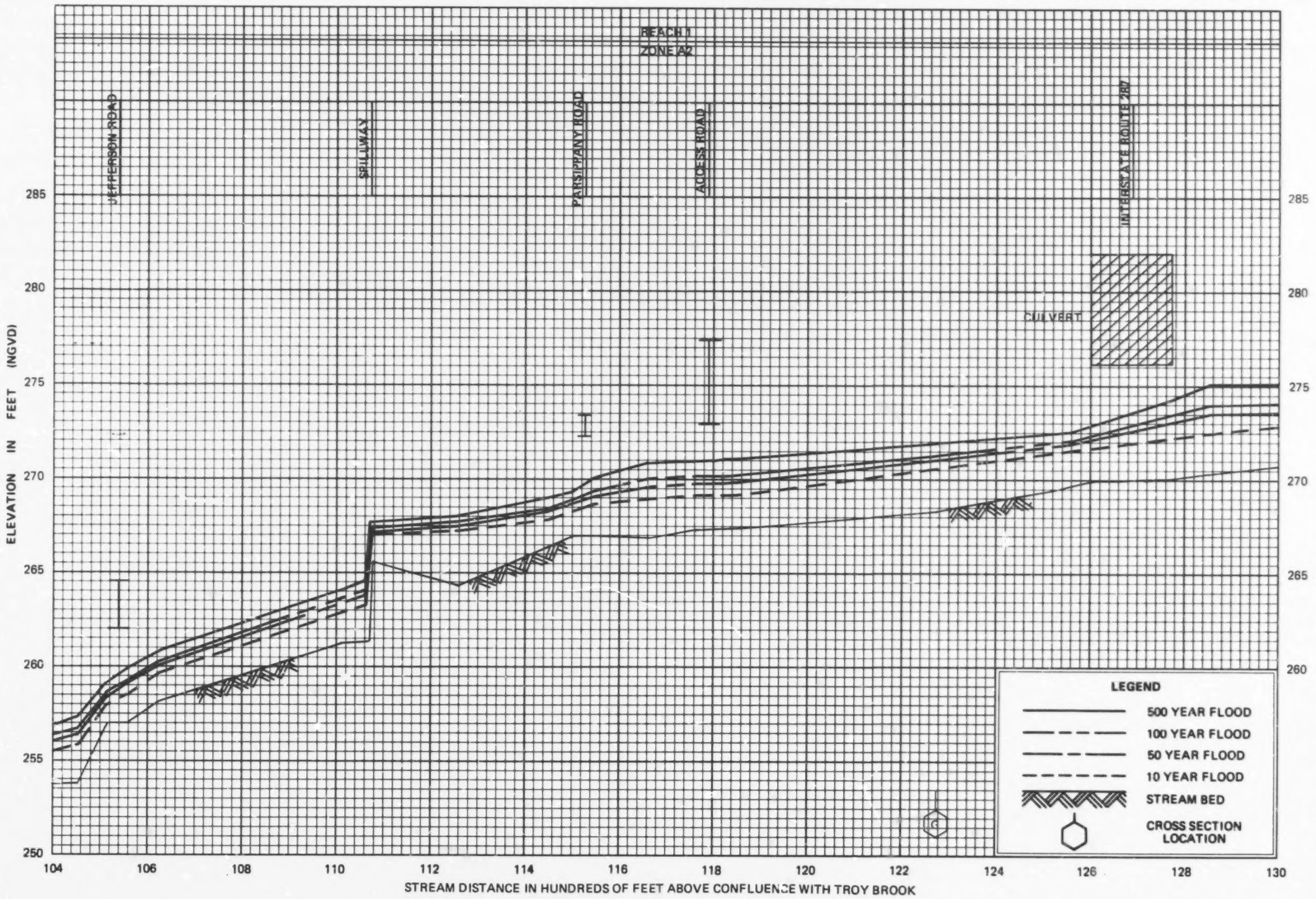

FLOOD PROFILES

EASTMANS BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF PARSIPPANY-TROY HILLS, NJ
(MORRIS CO.)

27P

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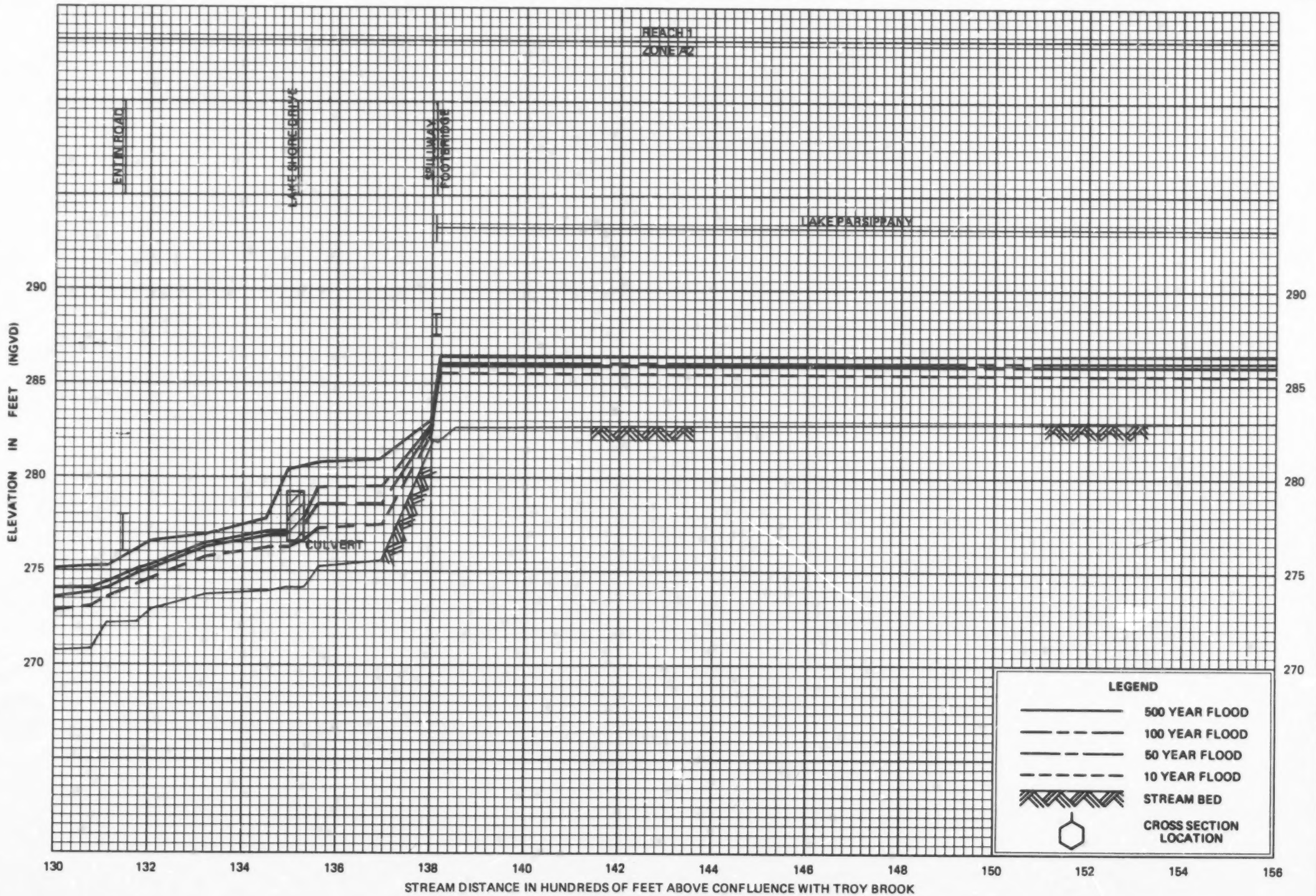

FLOOD PROFILES

EASTMANS BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF PARSIPPANY-TROY HILLS, NJ
(MORRIS CO.)

28P

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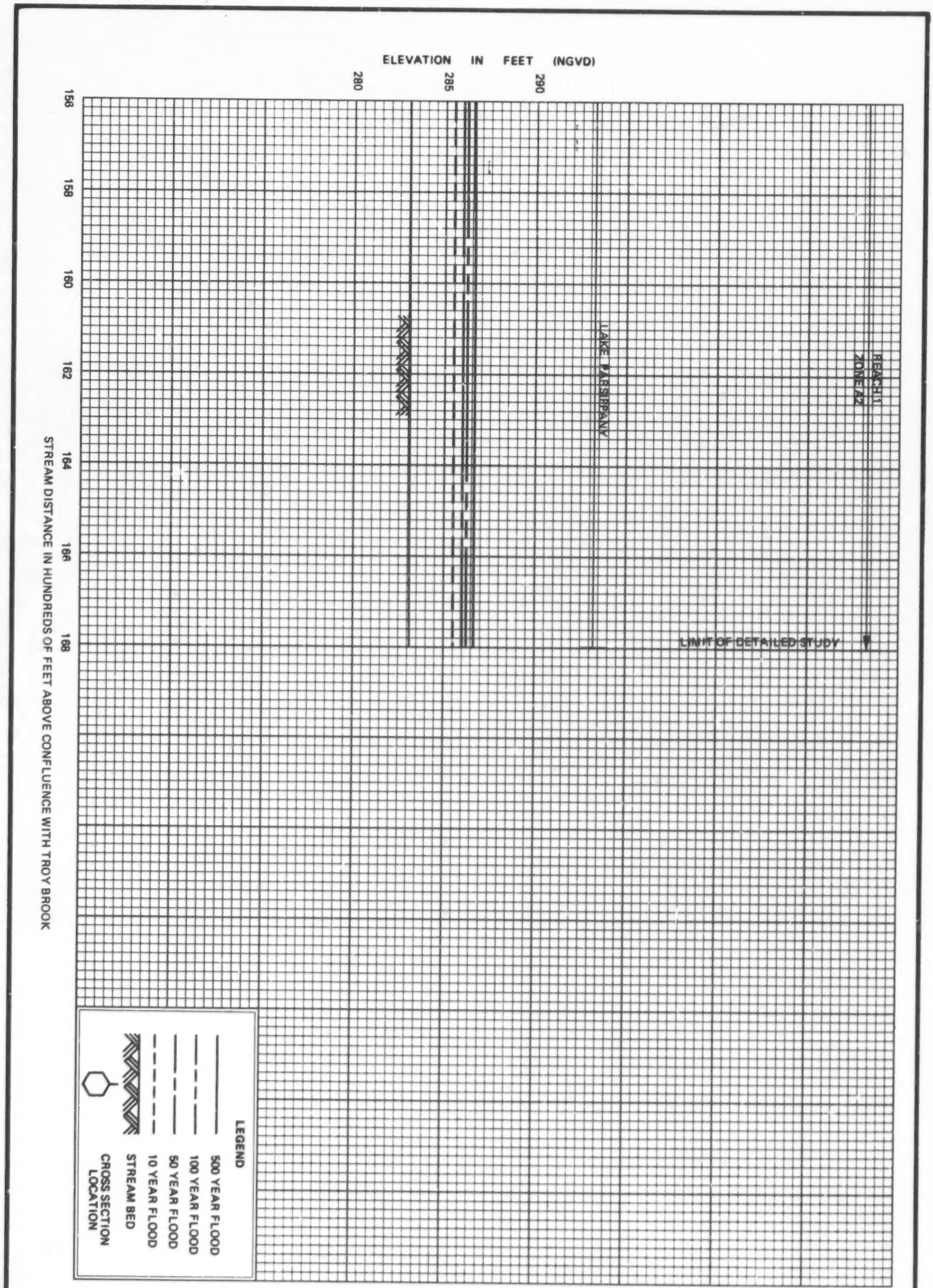

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF PARSIPPANY-TROY HILLS, NJ
(MORRIS CO.)

FLOOD PROFILES

EASTMANS BROOK

29P

53

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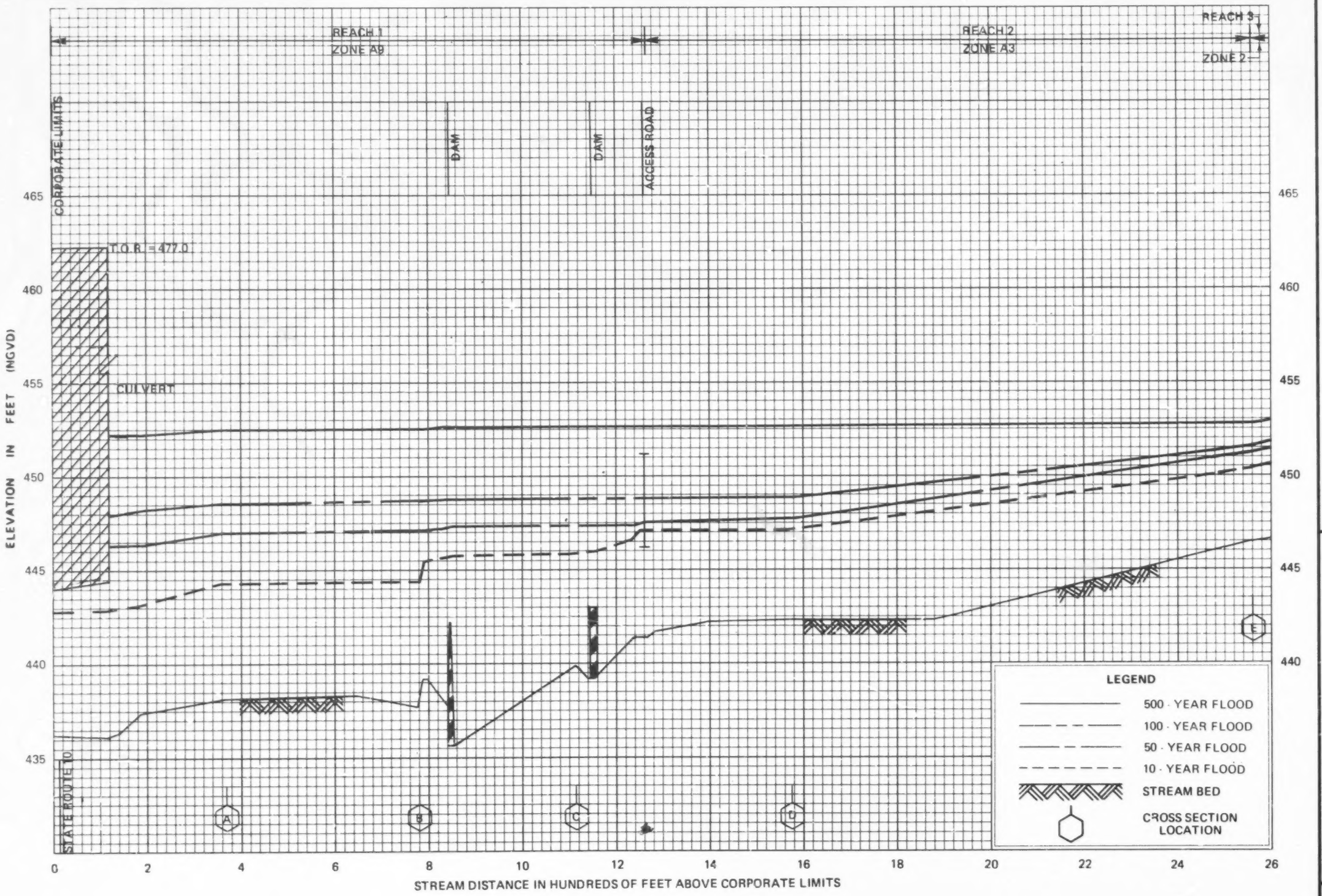

FLOOD PROFILES

WATNONG BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF PARSIPPANY-TROY HILLS, NJ
(MORRIS CO.)

30P

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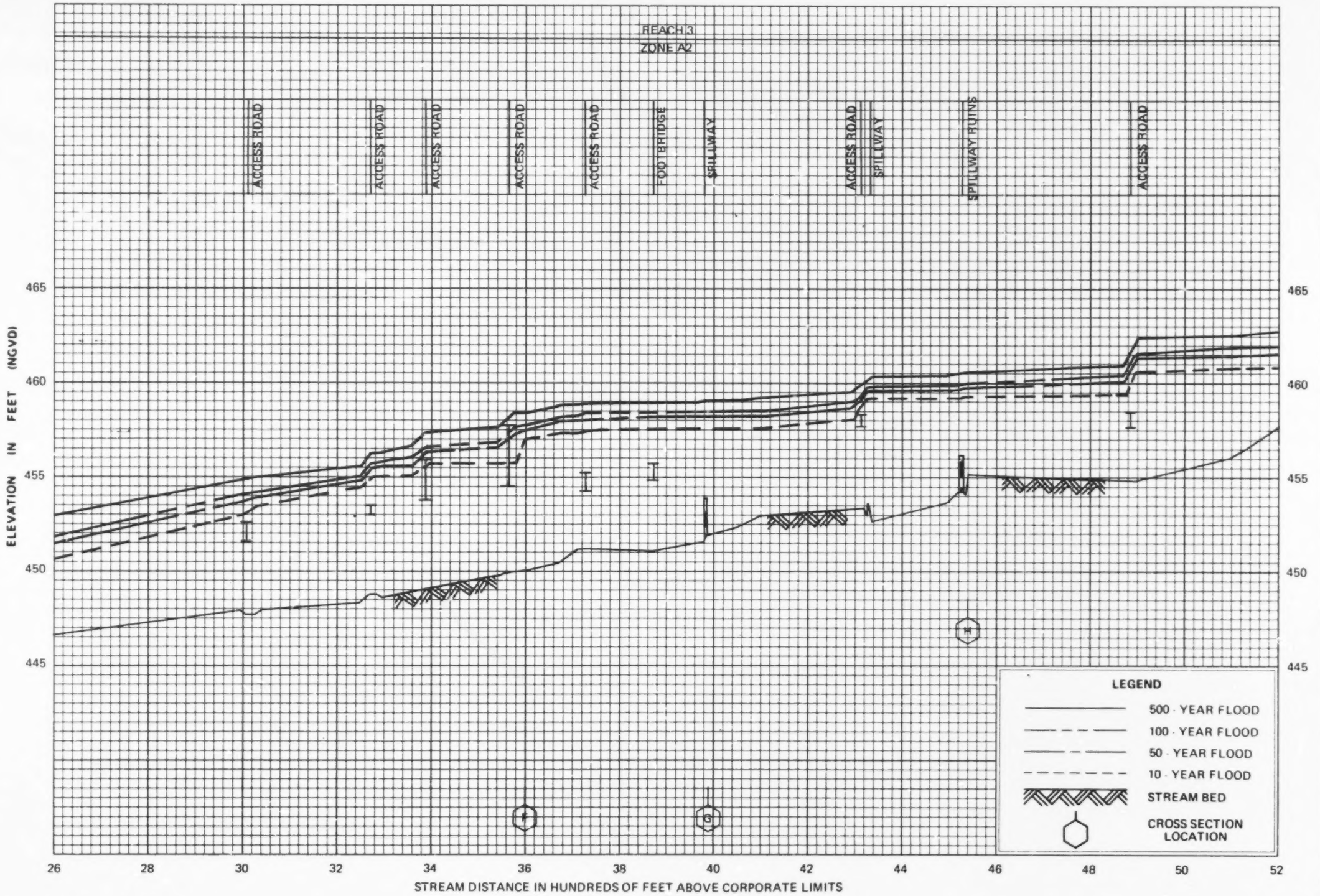

FLOOD PROFILES

WATNONG BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF PARSIPPANY-TROY HILLS, NJ
(MORRIS CO.)

31P

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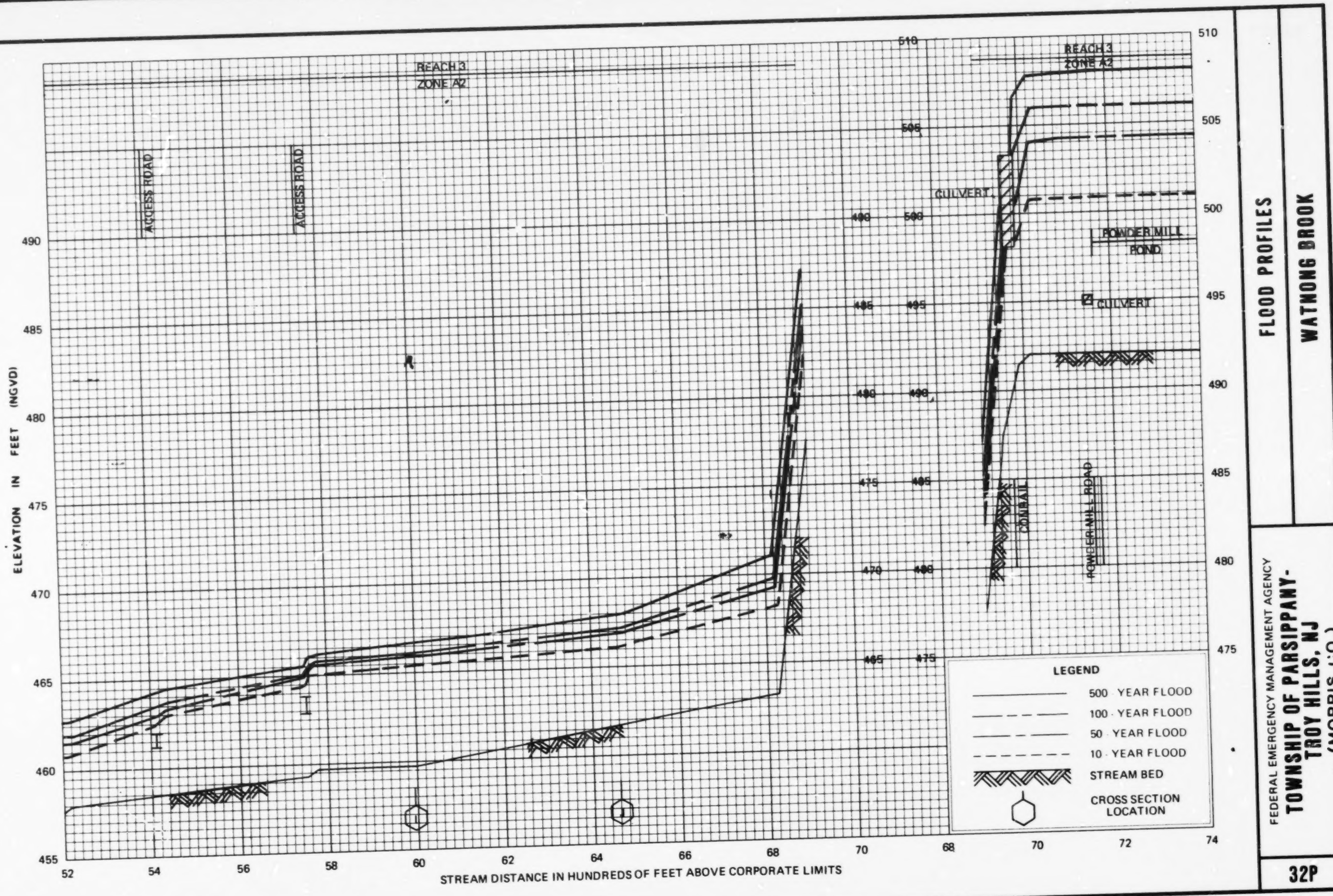

FLOOD PROFILES

WATNONG BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY
TOWNSHIP OF PARSIPPANY-TROY HILLS, NJ
(MORRIS CO.)

32P

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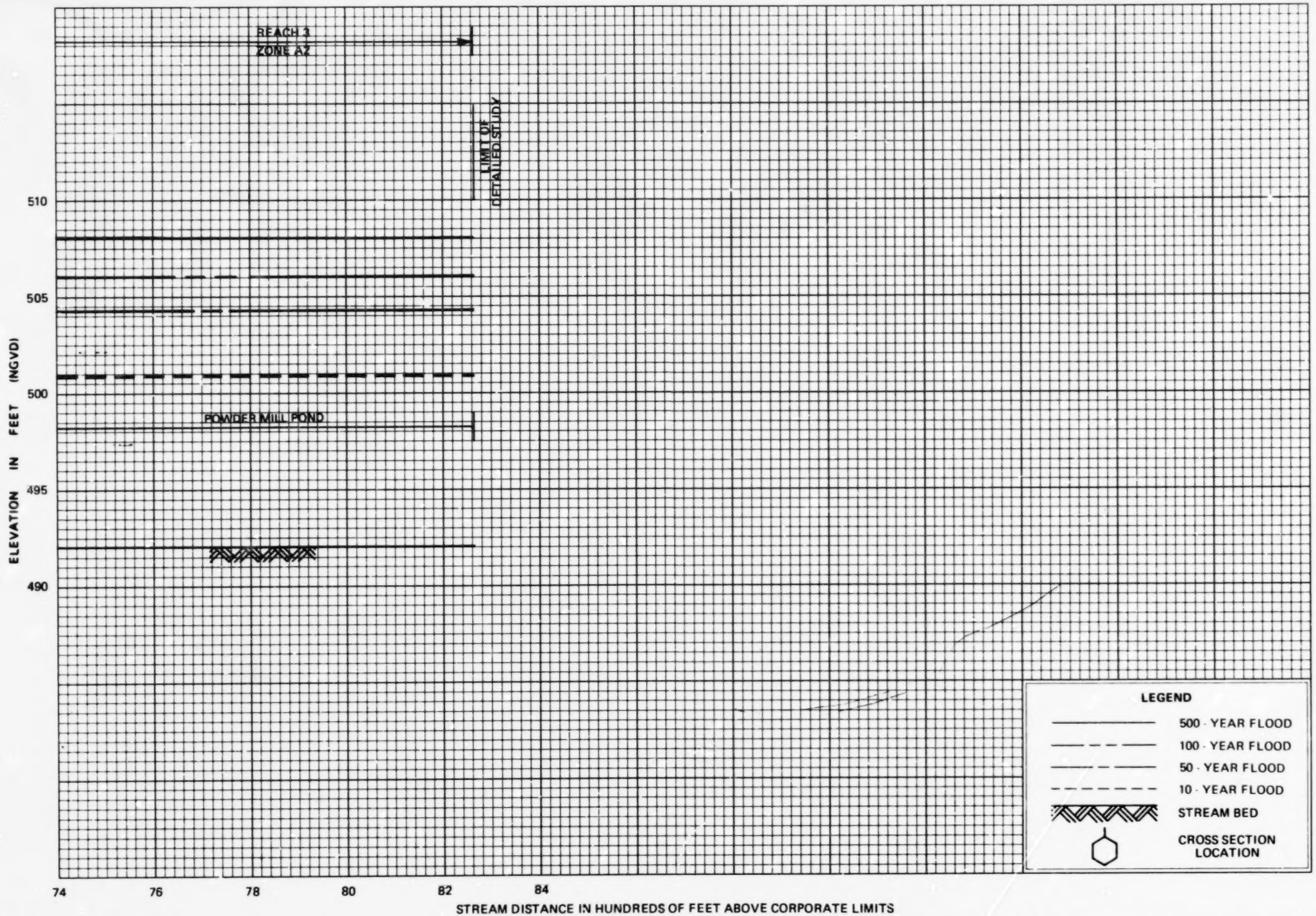

FLOOD PROFILES

WATNONG BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF PARSIPPANY-TROY HILLS, NJ
(MORRIS CO.)

33P

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